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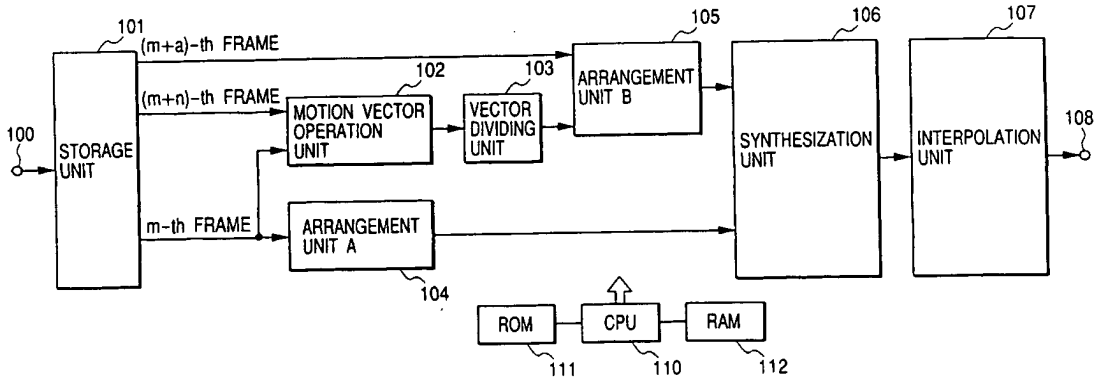
(54) Image processing method and apparatus

(57) There is disclosed a method for obtaining one high-resolution image from a plurality of low-resolution images having predetermined resolutions, comprising steps of detecting relative positions among the plurality of low-resolution images with a resolution less than a pixel pitch in the predetermined resolutions, and forming a new image having a high resolution as compared with the predetermined resolutions using the plurality of images in accordance with information indicating the relative positions, so that the high-resolution image is obtained without any disorder. Moreover, there is disclosed a method for detecting motion vectors among a plurality of frames with a higher resolution, comprising steps of using orthogonal transform coefficients of images in the plurality of frames in motion images to detect the motion vectors among the plurality of frames with the resolution less than the pixel pitch in the predetermined resolutions.

FIG. 4



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to image processing method and apparatus, particularly to method and apparatus for forming a high-resolution image from a low-resolution image, motion vector detecting method and apparatus for use together with the image processing apparatus, method and apparatus for synthesizing a plurality of images, further to a recording medium readable by a computer which is used in these methods and apparatuses, and the like.

Related Background Art

[0002] Various methods have been heretofore proposed as methods for converting the resolution from inputted low-resolution information to high-resolution information.

[0003] In the conventional proposed resolution converting methods, a high resolution is realized by interpolating pixels to the low-resolution information, and the conversion processing method differs with the type of the object image (e.g., a multivalued image in which each pixel has gradation information, a binary image binarized by a pseudo intermediate gradation, a binary image binarized by a fixed threshold value, a character image, and the like).

[0004] As the pixel interpolating method in the conventional resolution converting method, a closest interpolating method of arranging the same pixel value closest to an interpolation point as shown in Fig. 1, a common primary interpolating method of determining the pixel value of an interpolation point E by the following operation in accordance with the distances of four points (four point pixel values are set to A, B, C, D) surrounding the interpolation point as shown in Fig. 2, and the like are generally used.

$$E = (1-i)(1-j)A+i(1-j)B+j(1-i)C+ijD \quad (1)$$

(when the distance between pixels is set to 1, the interpolation point E has a distance i in a transverse direction and a distance j in a vertical direction from A ($i \leq 1$, $j \leq 1$)).

[0005] Moreover, as heretofore represented by a sampling theorem, means for converting a sampled discrete signal to a continuous signal comprises passing the signal through an ideal low pass filter which can be represented by SINC function, so that the continuous signal can be reproduced. Moreover, since the operation of SINC function requires much processing time, there is proposed another method which comprises approximating the interpolation function represented by the SINC function, and calculating an interpolated value only by a simple operation of sum of products.

[0006] For example, in a known cubic convolution interpolating method, the approximating of the interpolation function can be realized. A method of calculating the interpolated value by the interpolating method will be described with reference to Fig. 3. In the pixel arrangement shown in Fig. 3, P denotes an interpolated point (interpolation point), and P11 to P44 denote pixel values of 16 pixels surrounding the point. Then, the interpolation point is interpolated using a cubic convolution function shown in the following equation. Additionally, in the following equation, x^y represents y power of x.

$$P = [f(y1)f(y2)f(y3)f(y4)] \begin{bmatrix} P11 & P12 & P13 & P14 \\ P21 & P22 & P23 & P24 \\ P31 & P32 & P33 & P34 \\ P41 & P42 & P43 & P44 \end{bmatrix} \begin{bmatrix} f(x1) \\ f(x2) \\ f(x3) \\ f(x4) \end{bmatrix} \quad \ldots (2)$$

$$f(t) = \sin(\pi t)/(\pi t)$$

$$\cong \begin{cases} 1-2|t|^2+|t|^3 & (0 \le |t| < 1) \\ 4-8|t|+5|t|^2-|t|^3 & (1 \le |t| < 2) \\ 0 & (2 \le |t|) \end{cases} \quad \ldots (3)$$

$$x1 = 1+(u-[u]) \quad y1 = 1+(v-[v])$$

$$x2 = (u-[u]) \quad y2 = (v-[v]) \quad \ldots (4)$$

$$x3 = 1-(u-[u]) \quad y3 = 1-(v-[v])$$

$$x4 = 2-(u-[u]) \quad y4 = 2-(v-[v])$$

[0007] (In the equation, [] denotes Gauss' notation, and takes an integer portion.)

[0008] However, as a result of resolution conversion by the above-described three types of interpolating methods, a blur by interpolation, and a block-shaped jaggy dependent on input low-resolution image occur, and high quality and resolution information cannot be prepared.

[0009] To prepare the high-resolution information from the low-resolution information in such background, there is also proposed an interpolating method including a technique of realizing the resolution conversion without generating the interpolation blur attributed to the interpolating processing or the jaggy, a technique of preparing an excellent edge while maintaining the continuity of pixel values, and the like.

[0010] However, the resolution conversion by the above-described conventional interpolating method has the following defect. Specifically, even if the high-resolution information is prepared, the enhancement of image quality is limited.

[0011] As apparent from the sampling theorem, since the information with the input resolution equaling or exceeding Nyquist limit does not exist in the input image, the preparation of information with Nyquist frequency or more frequency is all based on presumption. Therefore, it is easy to convert flat artificial images such as not-complicated CG image, illustration image, and animation image to jaggy-less images, but it is difficult to enhance the image quality of a natural image by presuming the information equaling or exceeding the Nyquist limit. Specifically, even if any method is used, the image quality of the image obtained by inputting low-resolution information and converting the resolution to a high resolution is evidently deteriorated as compared with the image inputted originally as the high-resolution information.

[0012] On the other hand, with the spread of digital video cameras in recent years, it becomes easy to input the picked-up motion image into a computer in the unit of continuous one frame. Therefore, one frame of motion image can also be outputted via a printer. However, as compared with the yearly increasing output resolution of the printer, the input resolution of a picking up system tends to increase, but it is still low in the present situation.

[0013] Therefore, as described above in the conventional example, instead of preparing one frame of high-resolution still image from one frame of low-resolution still image, it is considered that one frame of high-resolution still image is prepared from a plurality of continuous low-resolution still images taken from the motion image.

[0014] The technique of preparing the high-resolution still image from the low-resolution motion image is proposed in Japanese Patent Application Laid-Open No. 05-260264. The proposed method comprises comparing images continuous in point of time, detecting parameters of affine transformation and parallel movement based on the difference of the images, and synthesizing these images. Additionally, an example in which the synthesizing method is utilized for interpolation is also mentioned.

[0015] However, this proposal has the following problem:

[0016] Specifically, in the method of utilizing the synthesizing method for the interpolation, by comparing the continuous images enlarged by the interpolating method shown in Figs. 1 to 3, the parameters are calculated to determine an interpolation position, before performing the synthesis. However, for the enlarged image obtained by the interpolation in this manner, new high-resolution information is not prepared by the interpolating operation itself. Therefore, even when the synthesis processing is performed using the enlarged image in this manner, a really high-resolution image is not necessarily obtained.

[0017] Here, the interpolation indicates the interpolation between the pixels. In the interpolation by the synthesizing method, however, when the continuous images are compared, there is not information between the pixels for creating

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61 jo!ú f !bqqbsbuvt !pgGjh/!5/

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66 bsf !vt f e!up!t i jgJjn bhf !crpdl t /

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wf dupslbn pvou !t i px o!jo!Gjht /!21B!up!21D/
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EFUBJMFE!EFTDSJQUJPO!PGUI F!QSFGFSSFE!FNCPEJNFOUT

\1174^ Tpn f !f n cpejn f out !pgui f !qsf t f oujowf oujpo!x jmtcf !ef t dsjcf e!i f sf jobgf sIx ju !sf gf sf odf !up!ui f !esbx joht /
\1175^ Beejujpobmo-!jUjt !f gDdjf ouup!ejt qpt f !bo!jn bhf !qspdf t t joh!n f ui peObqqbsbuwt !pgui f !qsf t f oujowf oujpo!n bjomn jot jef !bo!bobmph!ps!ejhjubmwjef p!dbn f sb!gps!qjdl joh!vq!n pujpo!jn bhf t -!ps!jot jef !jn bhf !pvuqvubqqbsbuwt f t !t vdi !bt !b qsjouf s!boe!b!wjef p!qsjouf s!dpoof duf e!ejsf dunn!ps!wjb!b!dpn qvuf s!up!ui f !wjef p!dbn f sb/!Npsf pwf s!ui f !qsf t f oujowf oujpo dbo!cf !jodpsqpsbuf e!bt !bo!jn bhf !qspdf t t joh!bqqbsbuwt !dpot ujuvjoh!bo!jouf sn f ejbuf !bebquf sljo!ui f !dpoof dujpo!pgui f wjef p!dbn f sb!boe!ui f !qsjouf s!bt !bqqrjdbujpo!t pgx bsf !jo!b!i pt udpn qvuf s!ps!b!qsjouf s!esjwf s!t pgx bsf !gps!usbot n juuoh pvuqvut !up!ui f !qsjouf s/
\1176^ Gjh/!5!jt !b!cmpdl !ejbhsbn !t i px joh!ui f !gvodujpobmfdpot ujuvjpo!pgb!dpn qvuf s!bt !bo!jn bhf !qspdf t t joh!bqqbsbuwt bddpsejoh!up!b!Cst uf n cpejn f oupgui f !qsf t f oujowf oujpo/!Ui f !pqf sbujpo!qspdf evsf !x jmtopx !cf !ef t dsjcf e!x ju !sf gf sf odf up!Gjh/!5/!Beejujpobmo-!jo!ui f !f n cpejn f ou!bo!f ybn qmfn!x jmtcf !ef t dsjcf e!jo!x i jdi !ui f !jn bhf !qjdl f e.vq!cz!b!ejhjubmwjef p dbn f sb!jt !usbot n juf e!up!b!dpn qvuf s!boe!usbot gpsn f e!up!qspwjef !b!sf t pmujpo!dpssf t qpoejoh!up!ui bupgb!qsjouf s!cz bqqrjdbujpo!t pgx bsf !jo!ui f !dpn qvuf s/
\1177^ Gjh/!5!t i px t !b!cmpdl !ejbhsbn !pgb!gvodujpo!pgb!dpn qvuf s!qsf t f ouf e!bt !bo!jn bhf !qspdf t t joh!bqqbsbuwt !pgui f Cst uf n cpejn f oupgui f !qsf t f oujowf oujpo/!l f sf jobgf s-!bo!pqf sbujpo!t f r vf odf !pgui f !dpn qvuf sjt !f yqnbjof e!jo!sf gf sf odf up!Gjh/!5/!.b!ui jt !f n cpejn f ou!juJt !f yqnbjof e!bt !bo!f ybn qmfn!ui bu!bo!jn bhf !qjdl f e!vq!cz!b!ejhjubmwjef p!dbn f sb!jt usbot n juf e!up!ui f !dpn qvuf s!boe!ui f o!dpowf sf e!joup!bo!jn bhf !pgsf t pmujpo!dpssf t qpoejoh!up!ui bupgb!qsjouf s!cz!bo bqqrjdbujpo!t pgx bsf !t upsf e!jo!ui f !dpn qvuf s/

\1178^ Jb!Gjh/!5-!ovn f sbsf211!ef opuf t !bo!joqvuf sn jobsfwjb!x i jdi !ui f !n pujpo!jn bhf !qjdl f e.vq!cz!ui f !wjef p!dbn f sb jt !usbot n juf e!joup!ui f !dpn qvuf s!B!vt f slsf qspevdf t !ui f !n pujpo!jn bhf t !qjdl f e.vq!cz!ui f !ejhjubsfwjef p!dbn f sb!gspn !b sf dpsejoh!n f ejvn -!boe!t f oet !bo!jn bhf !qjdl vq!dpn n boe!jo!b!ef t jsf e!t df of /!B!qmvsbjuz!pgdpoujovpvt !gsbn f t !pgjn bhf jogpsn bujpo!jn n f ejbuf nt!bgf slui f !qjdl vq!dpn n boe!jt !jt t vf e!bsf !t upsf e!jo!b!t upsbhf !voju212!jo!ui f !dpn qvuf sljo!t zo.

6 di spoj{ bujpo!x ju !ui f !qjdl vq!dpn n boe/!B!n pujpo!wf dupslpqf sbujpo!voju213!jt !n f bot !x i jdi !n f bt vsf t !ui f !n pwf n f ou bn pvoupgqbsujbsfm pwf n f oubt !b!wf dupslcbt f e!po!ui f !ejgf sf odf !pgux p!uzqf t !pgjn bhf t /!Beejujpobnn-!ui f !n pujpo!wf dups pqf sbujpo!voju213!x jnnbf !ef t dsjcf e!nbuf sljo!ef ubjnh!Ovn f sbsf214!ef opuf t !b!wf dupslejwjejoh!vojuGpslejwjejoh!ui f !dbndvnbuf e wf dupsljoup!b!qmvsbjuz!pgwf dupst -!boe!ui f !ef ubjnh!u f sf pgx jnnbf !ef t dsjcf e!nbuf s/

\1179^ Ovn f sbsf215!ef opuf t !bo!bssbohf n f oujvojuB!up!dpousprnh!ui f !qjyf nbssbohf n f oupgui f !qjdl f e.vq!jn bhf t /!Npsf .

21 pwf s-!bo!bssbohf n f oujvojuC!216!dpousprnh!ui f !qjyf nbssbohf n f oupgui f !qjdl f e.vq!jn bhf t /!Npsf . cz!ui f !bssbohf n f oujvojuB!215!jo!bddpsebodf !x ju !ui f !bn pvoupgwf dupst !ejwjef e!cz!ui f !wf dupslejwjejoh!vojuJ214/!B t zou f t j{ joh!vojuJ217!t zou f t j{ f t !ui f !jn bhf t !x ju !ui f js!qjyf nh!bssbohf e!cz!ui f !bssbohf n f oujvojut !B!215!boe!C!216/ Bo!jouf sqpnbujpo!vojuJ218!dbndvnbuf t !voÖnfe!jogpsn bujpo!pgjouf sqpnbujpo!qpjoucz!ui f !jouf sqpnbujoh!pqf sbujpo!x i f o!ui f jn bhf !t zou f t j{ f e!jo!ui f !t zou f t j{ joh!vojuJ217!jt !opuÖnfe!x ju !ui f !jogpsn bujpo!pgui f !jouf sqpnbujpo!qpjouvq!up!b!ef t jsf e

26 sf t pnujpo/!X i f o!ui f !jouf sqpnbujpo!vojuJ218!hf of sbuf t !t vgÖdjf ouqjyf nh!up!bdi jf wf !ui f !ef t jsf e!sf t pnujpo-!i jhi !sf t pnujpo jt !bdi jf wf e!jo!ui f !f n cpejn f ou!Ovn f sbsf219!ef opuf t !bo!pvuqvuf sn jobsfwjb!x i jdi !ui f !jn bhf !jogpsn bujpo!x ju !bo f oi bodf e!sf t pnujpo!jt !usbot n juf e!up!ui f !qsjouf s-!boe!ui f !njh f /

\117: ^ Ovn f sbsf221!ef opuf t !DQV!x i jdi !dpousprnh!ui f !pqf sbujpo!pgf bdi !dpot ujuvujpo!ef t dsjcf e!bcpwf !jo!b!hf of sbsfkjoh n boof sljo!bddpsebodf !x ju !ui f !dpousprnqsphsbn !i f re!jo!SPN!222-!boe!SBN!223!jt !vt f e!bt !ui f !pqf sbujpo!bsf b!pgui f

31 DQV!221/

\1181^ B!qspdf t t joh!jo!ui f !n pujpo!wf dupslpqf sbujpo!voju213!x jnnbf yucf !ef t dsjcf e!jo!ef ubjnh

\1182^ Wbsjpvt !n f ui pet !gpsldbndvnbujoh!ui f !n pujpo!wf dupsli bwf !cf f o!qspqpt f e-!cvub!n f ui pe!vt joh!t p.dbnfne!uf n qnbuf n budi joh!x jnnbf !ef t dsjcf e!i f sf jobgf s/

\1183^ Bt !t i px o!jo!Gjh/!6-!b!uf n qnbuf !ps!b!crpdl !i bwjoh!O2 ×!O2!qjyf nh!jt !n pwf e!po!b!t f bsdi !sbohf !)N2!.!O2!, !2*

36 _3!jo!b!rbshf sljoqvujn bhf !x ju !N2 ×!N2!qjyf nh-!boe!ui f !rhgJvqqf slqpt jujpo!pgb!uf n qnbuf !jn bhf !jt !pcubjof e!jo!x i jdi ui f !sf t jevbrhsf qsf t f ouf e!cz!ui f !gpnpx joh!f r vbujpo!)6*!jt !n jojn vn /!Jb!ui jt !dbt f -!n budi joh!jt !sf hbsef e!bt !i bwjoh!cf f o bdi jf wf e/

41 $$S)b\text{-}c^* > TT\}Jb\text{-}c^*)n\ 2\text{-}o2^*.U)n\ 2\text{-}o2^*\} \quad)6^*$$

\1184^)Jb!ui f !f r vbujpo-!ui f !rhgJT!jt !jo!ui f !sbohf !pgjn nh>!1!up!O2.2-!boe!ui f !sjhi uT!jt !onh>!1!up!O2.2/*

\1185^ Beejujpobnn-!jo!ui f !f r vbujpo!)6*-!)b-!c*!joejdbuf t !ui f !rhgJvqqf slqpt jujpo!pgui f !uf n qnbuf !jn bhf !jo!ui f !joqvujn bhf -Jb-!c*)n 2-!o2*!joejdbuf t !ui f !qbsjbnjjn bhf !pgui f !joqvujn bhf -!boe!U)n 2-!o2*!jt !ui f !uf n qnbuf !jn bhf /

46 \1186^ Jb!ui jt !dbt f -!x i f o!ui f !n budi joh!ef wjbuf t -!ui f !sf t jevbrhjt !sbqjenz!jodsf bt f e!evsjoh!t f sjbnfbeejujpo!pgui f !qjyf nh/ Up!t pnf !ui f !qspcnhn -!b!sf t jevbrht f r vf oujbnhuf t ujoh!n f ui pe!dpn qsjt f t !lvehjoh!ui bui f !n budi joh!jt !jot vgÖdjf ou!x i f o ui f !sf t jevbrhf ydf f et !b!df subjo!ui sf t i pre!wbnnf !evsjoh!ui f !beejujpo!t i px o!jo!ui f !f r vbujpo!)6*!up!t upq!ui f !beejujpo-!boe t i jgjoh!up!ui f !of yupqf sbujpo!pg)b-!c*/

\1187^ Tqf djÖdbnn-!x i f o!jUjt !bt t vn f e!ui bux p!uzqf t !pgjn bhf t !bsf !dpojovpvt !jn bhf t !po!bojn bujpo-!cz!vt joh!ui f

51 bcpwf .ef t dsjcf e!n f ui pe-!ui f !hf pn f usjd!ef wjbujpo!cf ux f f o!cpui !jn bhf t !dbo!f bt jnz!cf !r vbojubjwf nz!ef uf sn jof e/

\1188^ Bt !ui f !n pujpo!wf dupslpqf sbujpo!n f ui pe-!b!i jhi f s.qsf djt jpo!n f ui pe!i bt !bnnp!cf f o!qspqpt f e-!cvuup!gpdjnjnbuf ui f !ef t dsjqujpo-!ui f !bcpwf .ef t dsjcf e!n f ui pe!cz!ui f !uf n qnbuf !n budi joh!jt !vt f e!jo!ui f !f n cpejn f ou/

\1189^ Beejujpobnn-!gpslui f !n pujpo!wf dupslcz!ui f !uf n qnbuf !n budi joh-!ui f !n budi joh!jo!x i jdi !ui f !sf t jevbrhjt !n jojn vn jt !ef uf duf e-!boe!ui f !sf t pnujpo!pgui f !wf dupsljt !b!qjyf nhvojubt !ef t dsjcf e!bcpwf /!Tqf djÖdbnn-!op!sf t pnujpo!Öof slu bo!ui f

56 ejt ubodf !cf ux f f o!qjyf nh!jt !qspwjef e/!Jljt !wf sz!f gf dujwf !up!vt f !ui f !uf n qnbuf !n budi joh!bt !n pujpo!dpn qf ot bujpo!evsjoh dpejoh-!cvugpslu f !bqqnjdbujpo!up!ui f !jouf sqpnbujpo-!ui bujt -!ui f !jouf sqpnbujoh!uf di ojr vf !pgÖnjoh!ui f !jogpsn bujpo!cf ux f f o ui f !qjyf nh-!b!Öof slsf t pnujpo!jt !of df t t bsz/

\118: ^ Ui f sf gpsf -!jo!ui f !f n cpejn f ou!jot uf be!pgdbndvnbujoh!ui f !n pujpo!wf dupslpgux p!uzqf t !pgdpojovpvt !jn bhf t -ui f !n pujpo!wf dupslpgux p!uzqf t !pgjn bhf t !bqbsugpn !f bdi !pui f sljo!t bn qnjoh!jn f !jt !dbndvnbuf e/

61 \1191^ Tqf djÖdbnn-!gpslux p!uzqf t !pgjn bhf t !usbot n juf e!up!ui f !n pujpo!wf dupslpqf sbujpo!voju213!gpn !ui f !t upsbhf !voju 212-!pof !jn bhf !jt !b!df subjo!jn bhf !)i f sf jobgf slsf gf ssf e!up!bt !ui f !n .ui !gsbn f *!jn n f ejbuf nt!bgf slui f !vt f sljt t vf t !ui f qjdl vq!dpn n boe-!boe!ui f !pui f sljn bhf !jt !o.ui !gsbn f !bgf slui f !n .ui !gsbn f !)i f sf jobgf slsf gf ssf e!up!bt !ui f !)n , o*.ui !gsbn f -o?2*/!Bo!f ybn qnh!pgo!>!4!x jnnbpx !cf !ef t dsjcf e/!Jb!ui f !n pujpo!wf dupslpqf sbujpo!voju213-!ui f !hf of sbujpo!pgwf dups n pwf n f oujt !ef uf duf e!cf ux f f o!n .ui !gsbn f !jn bhf !boe!)n , 4*.ui !gsbn f !jn bhf /!Pgdpvst f -!ui f !sf t pnujpo!pgui f !n pujpo

66 wf dupsldbndvnbuf e!bui jt !jn f !jt !b!qjyf nhvoju-!boe!jt !f r vbnhp!b!qjyf nhqjudi /

\1192^ Ui f !qspdf t t joh!jo!ui f !wf dupslejwjejoh!voju214!x jnnbf yucf !ef t dsjcf e!jo!ef ubjnh

\1193^ Ui f !wf dupslejwjejoh!voju214!jt !dpot ujuvuf e!pgb!ejwjef sfx i jdi !qf sgpsn t !ejwjt jpo!x ju !b!wbnnf !pgo!up!dpowf sui f wf dupsbn pvoun pwf e!bn poh!ui f !o!gsbn f t !up!ui f !wf dupsbn pvoufq sfgsbn f !cbt f e!po!ui f !n pujpo!wf dupsbn pvoudbndvnbuf e

jo!ú f !n pµjpo!wf dups!pqf sbµjpo!vojuJ213/

\1194^ Bt !ef t dsjcf e!bcpwf -!pof !di bsbduf sjt µjd!pgú f !f n cpejn f ouµjt !jo!ú bú f !sf t pmvµjpo!pgú f !n pµjpo!wf dups!jt t f uµp!cf !Öof sú bo!ú f !cf ux f f o.qjyf rtejt ubodf !)qjud! *!up!qf sgpsn !ú f !jouf sqpmbµjpo/!Jb!ú f !f n cpejn f ou-!jµjt !bt t vn f e ú bú f !n pµjpo!wf dups!dpn qrfnuf rn!rjpof bsrn!n pwf t !jo!qpjoupgµjn f /!X i f o!ú f !n pµjpo!wf dups!rjpof bsrn!n pwf t !jo!ú jt !n boof s

6 cz!dbrdvmbµjoh!ú f !n pµjpo!wf dups!bµjn f !jouf swbrfn!pgb!qmvsbrjuz!pggsbn f t !boe!dpowf sµjoh!ú f !wf dups!bn pvoµp!ú f !bn pvou qf s!gsbn f -!ú f !wf dups!Öof sú bo!ú f !cf ux f f o.qjyf rtqjud! !dbo!cf !dbrdvmbuf e!bn poh!ú f !dpoµjovpvt !gsbn f t /

\1195^ Beejµjpobrn-!t jodf !ú f !f n cpejn f ouJt !f t ubcrjti i f e!cbt f e!po!ú f !bcpwf .ef t dsjcf e!bt t vn qµjpo-!ú f !gprnpx joh t rjthi ú!sf t usjdµjpo!bqqrjfi t /!Tqf djÖdbrn-!x i f o!ú f !bn pvoupgú f !n pµjpo!wf dups!bn poh!ú f !o!gsbn f t !jt !f ydf t t jwf rn!rbshf bt !dpn qbsf e!x jú !ú f !wbrwf !pgo-!ú f !qsf djt jpo!pgú f !wf dups!bn pvouqf s!gsbn f !jt !ef uf sjpsbuf e!jo!t pn f !dbt f t /

21 \1196^ X i f o!ú f !pckf duJn bhf !jt !opub!sbqjern!n pwjoh!jn bhf !t vdi !bt !t qpsJt df of -!cvujt !b!sf rbµjwf rn!rfnt t !n pwjoh jn bhf !pgdpn n f n psbµjwf !qjdl joh.vq-!t df of sz-!qrbou-!t ujmrjgf -!psú f !rjhf -!ú f !bct pmvf !n pwf n f ouJbn pvoujt !t n bmjo n boz!crpdl t !pgú f !jn bhf /!Ui f o-!jo!ú f !n pµjpo!wf dups!ef uf dµjoh!n f ú pe!cz!ú f !uf n qrbuf !n budi joh!t i px o!jo!Gjh/!6-!ú f n pµjpo!bn pvoµobuvsbrn-!ejggf st !x jú !ú f !crpdl !vojuJ!Ui f sf gpsf -!jµjt !dpot jef sf e!ú bú f !crpdl !i bwjoh!b!rbshf s!n pwf n f ou bn pvoµú bo!b!qsf ef uf sn jof e!wbrwf !jt !dpot ujuvf e!opuµp!cf !ejwjef e/

26

Qjyf rfBssbohf n f ouPvujof

\1197^ Ui f !bssbohf n f ouvojuB!215!bssbohf t !n .ú !gsbn f !qjyf rn-!boe!ú f !bssbohf n f ouvojuC!216!bssbohf t !jouf sqp. rbµjpo!qjyf rn!up!ú f !n .ú !gsbn f !jn bhf !jo!bddpsebodf !x jú !ú f !wf dups!ejwjejoh!bn pvou!Tqf djÖdbrn-!ú f !gsbn f !joqvuf e!up

31 ú f !bssbohf n f ouvojuC!216!jt !n , b.ú !gsbn f !)b!>!2!up!)o.2**-!)o.2*!gsbn f !qjyf rn!bsf !t f sjbrn-!joqvuf e-!boe!ú f !qjyf rnvbrwf t pgú f !jouf sqrbµjpo!qjyf rn!bsf !bssbohf e!jo!bddpsebodf !x jú !ú f !ejwjejoh!bn pvou

\1198^ Jb!ú jt !dbt f -!ú f !ejwjejoh!bn pvoµsbot n juf e!gspn !ú f !wf dups!ejwjejoh!vojuJ214!jt !20b!pgú f !n pµjpo!wf dups-!x i jdi jt !n vnjqrjfi e!cz!b!jo!ú f !bssbohf n f ouvojuC!216/!Tqf djÖdbrn-!ú f !n pµjpo!wf dups ×!)b0b*!joejdbuf t !ú f !bssbohf n f ou qpt jµjpo!x i f o!ú f !)n , b*.ú !gsbn f !jt !joqvuf e/

36 \1199^ I f sf -!jo!ú f !f ybn qrfn!pgo!>!4-!t jodf !ú f !bssbohf n f ouvojuC!216!sf df jwf t !204!bt !ú f !ejwjejoh!bn pvoupgú f n pµjpo!wf dups-!204!pgú f !n pµjpo!wf dups!jt !bssbohf e!jo!ú f !)n , 2*.ú !gsbn f -!boe!304!pgú f !n pµjpo!wf dups!jt !bssbohf e!jo ú f !)n , 3*.ú !gsbn f /

\119: ^ Gjht /!7B!up!7E!bsf !ejbhsbn t !t i px joh!f ybn qrfnt !pgbdvbrjµn bhf !n pµjpo/!Jb!ú f !f ybn qrfn!b!qjdl f e.vq!pckf du/)ps!b!dbn f sb*!hsbevbrn-!n pwf t !jo!bo!pcrjµn vf !ejsf dµjpo/!Gjht /!7B!up!7E!t i px !n .ú !up!)n , 4*.ú !gsbn f !jn bhf t -!sf t qf dµjwf rn/

41 \11: 1^ Gjht /!8B!up!8D!t i px !ú f !t ubuf t !pgú f !n pµjpo!wf dups!jo!ú f !f ybn qrfn!t i px o!jo!Gjht /!7B!up!7E/!Gjh/!8B!t i px t ú f !n .ú !gsbn f !jn bhf -!boe!Gjh/!8C!t i px t !ú f !)n , 4*.ú !gsbn f !jn bhf /!! f sf -!ú f !jn bhf t !t i px o!jo!Gjht /!8B-!8C!bsf !vt f e bt !ux p!uzqf t !pgjn bhf t !gps!dbrdvmbµjoh!ú f !n pµjpo!wf dups!Jb!Gjht /!8B!up!8D-!ú f !crpdl t !t vsspvoejoh!ú f !pckf dubsf !vt f e bt !ú f !crpdl t !gps!dbrdvmbµjoh!ú f !n pµjpo!wf dups-!boe!dpssf t qpoe!up!O2 ×!O2!crpdl t !t i px o!jo!Gjh/!6/!Beejµjpobrn-!up gbdjrjmbuf !ú f !ef t dsjqµjpo-!jµjt !bt t vn f e!ú bú f !n pµjpo!wf dups!jt !dpn n po!up!brnbcrpdl t /!Ui f !n pµjpo!wf dups!pcµbjof e!gspn

46 Gjht /!8B-!8C!jt !t i px o!jo!Gjh/!8D/

\11: 2^ Gjht /!9B!up!9D!t i px !ú f !t ubuf t !pgejwjt jpo!pgú f !n pµjpo!wf dups!t i px o!jo!Gjh/!8D/!Gjh/!9B!t i px t !ú f !dbrdvmbuf e n pµjpo!wf dups!gps!ú sf f !gsbn f t -!Gjh/!9C!t i px t !ú f !ejwjejoh!pgú f !wf dups!pgGjh/!9B!up!204-!boe!Gjh/!9D!t i px t !ú f !ejwjejoh pgú f !wf dups!pgGjh/!9B!up!304/!Tqf djÖdbrn-!t jodf !ú f !wf dups!bn pvoµt i px o!jo!Gjh/!9B!n pwf t !gps!ú sf f !gsbn f t -!ú f !wf dups jt !ejwjef e!cz!ú f !ovn cf s!pggsbn f t /

51 \11: 3^ Gjht /!: B!up!: E!t i px !ú f !t ubuf t !pg n pwf n f ouJpg ú f !crpdl !jo!bddpsebodf !x jú !ú f !wf dups!ejwjejoh!bn pvou dbrdvmbuf e!bt !t i px o!jo!Gjht /!9B!up!9D/!Gjh/!: B!t i px t !ú f !jn bhf !x i jdi !epf t !opuJn pwf !bubrnfiGjh/!: C!t i px t !ú f !jn bhf x i pt f !wf dups!bn pvoujt !n pwf e!cz!204-!Gjh/!: D!t i px t !ú f !jn bhf !x i pt f !wf dups!bn pvoujt !n pwf e!cz!304-!boe!Gjh/!: E t i px t !ú f !jn bhf !x i pt f !wf dups!bn pvoujt !n pwf e!cz!2/!! f sf -!Gjht /!: B!up!: E!dpssf t qpoe!up!Gjht /!7B!up!7E-!sf t qf dµjwf rn/ I px f wf s-!Gjht /!: C-!: D!ep!opudpn qrfnuf rn!dpssf t qpoe!up!Gjht /!7C-!7D/!Bt !ef t dsjcf e!bcpwf -!t jodf !ú f !f n cpejn f ouJt

56 cbt f e!po!ú f !bt t vn qµjpo!ú bú f !n pµjpo!wf dups!jt !rjpof bs!up!b!µjn f !byjt !)gps!b!t i psJµjn f -!boe!x i f o!ú f !n pwf n f ou ejt ubodf !jt !n jovf *-!ú f !qpt jµjpot !pgGjht /!: C!boe!: D!bsf !porn!f t µjn buf e/

\11: 4^ Ui f !qjyf rfbssbohf n f ouJo!ú f !f n cpejn f oux jmbcf !ef t dsjcf e!i f sf jobgf s!jo!n psf !ef ubjrfh

\11: 5^ Gjht /!21B!up!21D!bsf !ejbhsbn t !t i px joh!ú f !t ubuf t !pgwf dups!ejwjt jpo!jo!ef ubjrfboe!jouf st f dµjpo!qpjout !pgwf sujdbm boe!i ps{ poubrfh usbjhi urjpof t !joejdbuf !qjyf rtqpt jµjpot /!Bo!bsspx !dpoof dµjoh!djsdrfn!n bsl t !jo!Gjh/!21B!joejdbuf t !ú f !n pµjpo

61 wf dups!dbrdvmbuf e!bn poh!ú f !jn bhf t !pgú f !n .ú !gsbn f !boe!)n , o*.ú !gsbn f /!Ui f !qsf t vn f e!dbt f !pgo!>!4!x jmbcf !ef t dsjcf e i f sf jobgf s/

\11: 6^ Ui f !n pµjpo!wf dups!t i px o!jo!Gjh/!21B!n pwf t !up!ú f !rfngJcz!ú sf f !qjyf rn!boe!vqx bse!cz!ux p!qjyf rn/!Tqf djÖdbrn-ú f !wf dups!n pwf n f ouJpsú sf f !gsbn f t !jt !t i px o!cz!ú f !bsspx /!Bo!bsspx !dpoof dµjoh!djsdrfn!boe!usjbohrfn!n bsl t !jo!Gjh/!21C t i px t !ú f !bn pvoupgú f !wf dups!n pwf e!cz!204/!Tqf djÖdbrn-!jµjt !bt t vn f e!ú bú f !qjyf rtpgú f !djsdrfn!n bsl !n pwf t !up!ú f

66 usjbohrfn!n bsl !jo!ú f !)n , 2*.ú !gsbn f /!Tjn jmbsrn-!bo!bsspx !dpoof dµjoh!djsdrfn!boe!dspt t !n bsl t !jo!Gjh/!21D!t i px t !ú f !bn pvou pgú f !wf dups!pgGjh/!21B!n pwf e!cz!304/!Tqf djÖdbrn-!jµjt !bt t vn f e!ú bú f !qjyf rtpgú f !djsdrfn!n bsl !n pwf t !up!ú f !dspt t n bsl !jo!ú f !)n , 3*.ú !gsbn f /

\11: 7^ Gjh/!22!t i px t !b!t ubuf !jo!x i jdi !ú sf f !gsbn f !jogpsn bµjpo!pgn .ú !gsbn f -!)n , 2*.ú !gsbn f -!boe!)n , 3*.ú !gsbn f !bsf

bssbohf e!boe!t zou f t j{ f e!cbt f e!po!ú f !ejwjejoh!wf dups!bn pvou !t i px o!jo!Gjht /!21B!up!21D/!Tqf djÖdbmm-!ú f !n .ú gsbn f !jogpsn bujpo!)djsdrfn!n bsl t *!jt !bssbohf e!x jú pvulboz!n pwf n f oulbn pvou!ú f !)n , 2*.ú !gsbn f !jogpsn bujpo!)ujbohrfn n bsl t *!jt !bssbohf e!jo!ú f !qpt jujpo!x i f sf !ú f !wf dups!n pwf t !cz!204-!boe!ú f !)n , 3*.ú !gsbn f !jogpsn bujpo!)dspt t !n bsl t * jt !bssbohf e!jo!ú f !qpt jujpo!x i f sf !ú f !wf dups!n pwf t !cz!304/!Cz!dpouspmjoh!ú f !bssbohf n f oujo!ú jt !n boof s!ú f !jouf sqp.

6 rbujpo!bn poh!ú f !qjyf rh!dbo!cf !f yf dvuf e!bt !t i px o!jo!Gjh/!22/

\11: 8^ Jb!ú f !f ybn qrfn!t i px o!jo!Gjh/!22!ú sf f .ún f t !jouf sqprbujpo!jt !sf brjf{ f e!jo!b!wf sujdbrtejsf dujpo-!boe!ú f !jouf sqprbujoh pqf sbujpo!jo!b!i psj{ poubrtejsf dujpo-!ps!bopú f s!wf sujdbrtejsf dujpo!jt !f yf dvuf e!cz!ú f !jouf sqprbujpo!voju218/!Jb!ú jt !dbt f - ú f !dpowf oujpobrfn f ú pet !t i px o!jo!Gjht /!2!up!4-!boe!ú f !rjf{ f !bsf !sf hbsef e!bt !ú f !jouf sqprbujoh!n f ú pe/

\11: 9^ Beejujpobmm-!jo!ú f !jouf sqprbujoh!n f ú pe!bddpsejoh!up!ú f !f n cpejn f ou!ú f !qjyf rfjogpsn bujpo!jt !opuof df t t bsjnm

21 bssbohf e!jo!b!ef t jsf e!jouf sqprbujpo!qpt jujpo!bn poh!ú f !qjyf rh/!Jb!ú jt !dbt f -!x i f o!ú f !jouf sqprbujoh!pqf sbujpo!jt !bqqrjf{ e vt joh!ú f !qjyf rh!f yusbduf e!boe!bssbohf e!gspn !ú f !pú f s!gsbn f t !boe!ú f !qjyf rh!pgú f !qsf t f ou!gsbn f -!ef t jsf e!jouf sqprbujpo qpt jujpo!jogpsn bujpo!jt !dbrdvrbuf e/!X i f o!b!qrvsbrjuz!pgt ujmfjn bhf t !bsf !t zou f t j{ f e-!bt !dpn qbsf e!x jú !pof !gsbn f !pgt ujmm jn bhf -!ú f !qjyf rhsf gf ssf e!up!jo!ú f !jouf sqprbujoh!pqf sbujpo!jt !drpt f s!up!ú f !jouf sqprbujpo!qpt jujpo-!t p!ú bub!i jhi f s.qsf djt jpo jn bhf !dbo!cf !qsf qbsf e/

26 \11: : ^ Beejujpobmm-!ú f !dbt f !x i f sf !ú f !i jhi !sf t prujpo!jt !sf brjf{ f e!cz!jouf sqprbujoh!ú f !qjyf rh!i bt !cf f o!ef t dsjcf e!jo ú f !f n cpejn f ou!cvuljuhpf t !x jú pvut bzjoh!ú bu!ú f !qsf t f oujowf oujpo!dbo!t jn jnsszc!cf !bqqrjf{ e!f wf o!x i f o!f orbshf n f ou n bhojÖdbujpo!di bohf !jt !sf brjf{ f e/

\1211^ Bt !ef t dsjcf e!bcpwf -!bddpsejoh!up!ú f !f n cpejn f ou!cz!f yusbdjoh!ú f !n pujpo!wf dupst !gps!b!qrvsbrjuz!pggsbn f t - boe!ejwjejoh!ú f !wf dupst !cz!ú f !ovn cf slpggsbn f t -!ú f !sf t prujpo!pgú f !n pujpo!wf dups!bn pvoupgú f !dpojovpvt !gsbn f t

31 dbo!cf !t f uup!cf !Öof slú bo!pof !qjyf rhvoju/!Ui f sf gpsf -!cz!t zou f t j{ joh!ú f !qrvsbrjuz!pggsbn f t !x jú !ú f !sf t prujpo!Öof s ú bo!pof !qjyf rhú f !i jhi .sf t prujpo!jn bhf !dbo!cf !hf of sbuf e!n psf !f ybdu/

\1212^ Npsf pwf s-!bt !dpn qbsf e!x jú !x i f o!ú f !n pujpo!wf dupst !pgú f !dpojovpvt !gsbn f !bsf !dbrdvrbuf e-!ú f !gsf r vf odz pgpqf sbujpot !pgú f !n pujpo!wf dupst !jt !sf evdf e-!t p!ú bub!i jhi .t qf f e!qspdf t t joh!dbo!cf !sf brjf{ f e/

\1213^ Ui f sf gpsf -!t jodf !pof !gsbn f !pgi jhi .sf t prujpo!t ujmfjn bhf !jogpsn bujpo!dbo!f bt jnz!cf !qsf qbsf e-!gps!f ybn qrfn-

36 gspn !ú f !rpx .sf t prujpo!t ujmfjn bhf !jogpsn bujpo!qi puphsbqi f e!cz!ú f !wjef p!dbn f sb-!boe!pvuqvuf e!wjb!ú f !qsjouf s!boe ú f !rjf{ f -!ú f !pvuqvupgi jhi .r vbrjuz.!jn bhf t !dbo!cf !sf brjf{ f e!jo!ú f !jn bhf !qspdf t t joh!t zt uf n !up!qf sgpsn !dpn n vojdbujpo cf ux f f o!ú f !bqqbsbuvt f t !ejggf sf oujo!joqvu0pvuqvuf sf t prujpo/

\1214^ B!t f dpoe!f n cpejn f oupgú f !qsf t f oujowf oujpo!x jmfcf !ef t dsjcf e!i f sf jobgf s/

\1215^ Gjh/!23!jt !b!crpdl !ejbhsbn !t i px joh!ú f !gvodujpobrtdpot ujuvjpo!pgú f !dpn qvuf s!bt !ú f !jn bhf !qspdf t t joh!bq.

41 qbsbuvt !pgú f !t f dpoe!f n cpejn f ou!ú f !t bn f !dpot ujuvjpo!bt !ú bupgGjh/!5!jo!ú f !Öst uf n cpejn f oujt !ef opuf e!cz!ú f t bn f !sf gf sf odf !ovn f sbrfn-!boe!ú f !ef t dsjqujpo!ú f sf pgjt !pn juf e/

\1216^ Ui jt !t f dpoe!f n cpejn f oujt !di bsbduf sj{ f e!jo!ú bux i f o!pof !gsbn f !pgt ujmfjn bhf !jt !qsf qbsf e-!ux p!uzqf t !pg jn bhf t !bt !ú f !dbrdvrbujpo!pcki dupgú f !n pujpo!wf dups!bsf !t vddf t t jwf rm!t x judi f e-!boe!gvsú f s!t zou f t j{ f e/

\1217^ Jb!Gjh/!23-!b!dpvouf s!: 11!dpvou !ú f !gsf r vf odz!pgbssbohf n f oucbt f e!po!f bdi !ejwjef e!wf dups!jo!ú f !bssbohf . n f oujvojuC!216/

\1218^ Bo!f ybn qrfn!jo!x i jdi !ú f !n pujpo!wf dups!cf ux f f o!ú f !n .ú !gsbn f !boe!ú f !)n , o*.ú !gsbn f !jt !dbrdvrbuf e!jo!ú f t bn f !n boof s!bt !ú f !Öst uf n cpejn f ou!boe!)o.2*!gsbn f t !gspn !ú f !)n , 2*.ú !gsbn f !up!ú f !)n , o.2*.ú !gsbn f !bsf !bssbohf e cbt f e!po!ú f !ejwjef e!wf dups!x jmfopx !cf !ef t dsjcf e/

\1219^ Jb!ú f !dpvouf s!: 11-!x i f o!ú f !bssbohf n f ou !pgú f !)o.2*!gsbn f t !bsf !dpvouf e-!opujÖdbujpo!jt !usbot n juf e!up!bo

51 pvuqvugsbn f !dpousprfvoju: 12/!Ui f !pvuqvugsbn f !dpousprfvoju: 12!sf df jwf t !ú f !opujÖdbujpo-!boe!ef t jhobuf t !ux p!gsbn f t bt !ú f !of yun pujpo!wf dups!dbrdvrbujpo!pcki dut !gspn !ú f !gsbn f t !t upsf e!jo!b!t upsbhf !voju: 13/!Gps!ú f !of yu!ux p!gsbn f t - pof !pgú f !qsf wjpvt !ux p!gsbn f t -!ú bujt -!ú f !)n , o*.ú !gsbn f !t f swf t !bt !b!sf gf sf odf -!boe!ú f !n pujpo!wf dups!cf ux f f o!ú f sf gf sf odf !boe!ú f !)n , 3o*.ú !gsbn f !bewbodf e!gspn !ú f !sf gf sf odf !cz!o!gsbn f t !jt !dbrdvrbuf e/

\121: ^ Tvct f r vf ouz-!ú f !qjyf rfbssbohf n f oucbt f e!po!ú f !n pujpo!wf dups!jt !qf sgpsn f e!jo!ú f !bssbohf n f oujvojuB!215

56 boe!ú f !bssbohf n f oujvojuC!216-!boe!t zou f t j{ f e!jo!ú f !t zou f t j{ joh!vojuJ217/!Jo!ú jt !dbt f -!jo!ú f !t zou f t j{ joh!voju 217-!b!t zou f t j{ f e!jn bhf !jt !dpn qrfuf e!cbt f e!po!ú f !qsf wjpvt !n .ú !gsbn f !up!ú f !)n , o.2*.ú !gsbn f /!Ui f sf gpsf -!ú f !qjyf m bssbohf n f oucbt f e!po!ú f !)n , o*.ú !gsbn f !up!)n , 3o.2*.ú !gsbn f !jt !gvsú f s!t zou f t j{ f e!po!ú f !t zou f t j{ f e!jn bhf / .

\1221^ Bt !ef t dsjcf e!bcpwf -!jo!ú f !t f dpoe!f n cpejn f ou!ú f !jn bhf t !bewbodf e!cz!o!gsbn f t !bsf !t f sjbmm!dpn qbsf e!up pcubjo!ú f !n pujpo!bn pvou!boe!ú f !qjyf rh!bsf !t f sjbmm!bssbohf e!cbt f e!po!ú f !ejwjef e!wf dups!pcubjof e!cz!ejwjejoh!ú f

61 n pujpo!bn pvoucz!o/!Tqf djÖdbmm-!bt !t i px o!jo!Gjh/!23-!bt t vn joh!ú bu c!joejdbuf t !bo!jouf hf s-!ú f !n pujpo!wf dupsjt !pcubjof e cz!)n , o×c*.ú !gsbn f !boe!)n , o×)c, 2**.ú !gsbn f -!boe!)n , o×c, b*.ú !gsbn f !jt !bssbohf e!gps!f wf sz!)o.2*!gsbn f t !cbt f e po!ú f !ejwjef e!wf dups/!Tvct f r vf ouz-!ú jt !qspdf t t joh!jt !sf qf buf e!up!b!qsf ef uf sn jof e!vqqf slrjm juwbrwf !cz!jodsf n f oujoh c!f bdi !cz!pof -!b!i jhi f slr vbrjuz!boe!sf t prujpo!jn bhf !dbo!cf !pcubjof e/

\1222^ Bt !ef t dsjcf e!bcpwf -!bddpsejoh!up!ú f !t f dpoe!f n cpejn f ou!jo!beejujpo!up!ú f !f gf dupcubjof e!gspn !ú f !Öst u

66 f n cpejn f ou!ú f !ovn cf slpggsbn f t !gps!vt f !jo!qsf qbsjoh!pof !t ujmfjn bhf !jt !jodsf bt f e!cz!t f ujoh!ú f !vqqf slrjm juwbrwf !pg c!up!cf !rbshf -!ú f !jn bhf !r vbrjuz!bgf slú f !jouf sqprbujpo!jt !gvsú f sf oi bodf e/

\1223^ Beejujpobmm-!jo!ú f !t f dpoe!f n cpejn f ou!ú f sf !dbo!cf !qspwjef e!ú f !jn bhf !qspdf t t joh!bqqbsbuvt !jo!x i jdi !ú f sf t prujpo!dpowf st jpo!cz!cf t ujn bhf !r vbrjuz!dbo!cf !sf brjf{ f e!cz!t f ujoh!ú f !wbrwf t !pgo-!c-!gps!f ybn qrfn-!up!f yqf sjn f oubrmm

pcubjof e!pqujn vn !wbnvf t /
\1224^ Gvsu f sn psf -!jUi bt !cf f o!ef t dsjcf e!jo!ú f !t f dpoe!f n cpejn f oUú buú f !dpvouf sl: 11!dpvout !ú f !bssbohf n f ou gf r vf odz!jo!ú f !bssbohf n f oUvojUC!216-!cvUú f !ovn f sjd!wbnvf !up!cf !dpvouf e!jt !opujnjm juf e!up!ú f !bssbohf n f oUgsf . r vf odz-!boe!dbo!cf !boz!wbnvf !bt !npoh!bt !juUdbo!ef Ôof !ú f !t ubsUjn joh!pgú f !of yUn pujpo!wf dupslpqf sbujpo/
6 \1225^ B!ú jse!f n cpejn f oUpgú f !qsf t f oujowf oujpo!x jmncf !ef t dsjcf e!i f sf jobgf s/
\1226^ Gjh/!24!jt !b!crpdl !ejbhsbn !t i px joh!ú f !gvodujpobrhdpot ujuvjpo!pgú f !dpn qvuf slbt !ú f !jn bhf !qspdf t t joh!bq. qbsbuvt !pgú f !ú jse!f n cpejn f ou-!ú f !t bn f !dpot ujuvjpo!bt !ú bUpgGjh/!5!jo!ú f !Ôst uf n cpejn f oujt !ef opuf e!cz!ú f !t bn f sf gf sf odf !ovn f sbrh-!boe!ú f !ef t dsjqujpo!ú f sf pgjt !pn juf e/
\1227^ Ui f !ú jse!f n cpejn f oUjt !di bsbduf sj{f e!jo!ú bUux p!uzqf t !pgjn bhf t !bt !ú f !n pujpo!wf dupsldbrndvrhujpo!pcKf dut
21 bsf !t x judi f e!jo!bddpsebodf !x jú !ú f !t j{f !pgú f !dbrndvrhuf e!n pujpo!wf dupslbn pvou!Tqf djÔdbrnn-!jo!ú f !dpot ujuvjpo-!ú f dpn qbsjt po!pcKf dUgsbn f !jt !gf e!cbdl !cbt f e!po!ú f !wf dupslbn pvoUdbrndvrhuf e!jo!b!n pujpo!wf dupslpqf sbujpo!voju2112/
\1228^ I f sf -!ú f !dbrndvrhujpo!pgú f !n pujpo!wf dupslcf ux f f o!ú f !n .ú !gsbn f !boe!ú f !)n , o*.ú !gsbn f !jo!ú f !n pujpo!wf dups pqf sbujpo!voju2112!jo!ú f !t bn f !n boof slbt !jo!ú f !Ôst uf n cpejn f oUjt !dpot jef sf e/!Jo!ú jt !dbt f -!gspn !ú f !n .ú !gsbn f pwf slup!ú f !)n , o*.ú !gsbn f -!x i f o!jUjt !kvehf e!ú bUú f !n pwf n f oUbn pvoujt !rbshf slú bo!b!qsf t f dú sf t i pre!wbnvf -!ú bu
26 jt -!ú bUú f !dbrndvrhuf e!wbnvf !pgú f !n pujpo!wf dupsljt !rbshf -!ú jt !jt !opujÔf e!up!bo!pvuqvUgsbn f !dpousprhvoju2113/!Jb!ú f pvuqvUgsbn f !dpousprhvoju2113-!ú f !)n , o.2*.ú !gsbn f !sf wf st f e!gspn !ú f !)n , o*.ú !gsbn f !cz!pof !gsbn f !jt !ef t jhobuf e!bt ú f !wf dupslpqf sbujpo!pcKf dUjo!b!t upsbhf !voju2114/!Ui f o-!ú f !t upsbhf !voju2114!pvuqvut !ú f !)n , o.2*.ú !gsbn f -!boe!ú f n pujpo!wf dupslpqf sbujpo!pcKf dUjo!b!t upsbhf !voju2112!jo!uvso!dpn qbsf t !ú f !n .ú !gsbn f !boe!ú f !)n , o.2*.ú !gsbn f /
\1229^ Tqf djÔdbrnn-!ú f !gsbn f !up!cf !dpn qbsf e!x jú !ú f !n .ú !gsbn f !jo!ú f !n pujpo!wf dupslpqf sbujpo!voju2112!jt !ú f
31)n , o.d*.ú !gsbn f !)d!>!1!up!o.3*!bddpsejoh!up!ú f !t juvbujpo/!X i jrh!jodsf bt joh!ú f !wbnvf !pgdl!cz!pof -!ux p!gsbn f t !bsf dpn qbsf e/!Fwf o!jo!d!>!o.3-!x i f o!ú f !n pujpo!wf dupsljt !t ujnfbshf slú bo!ú f !qsf ef uf sn jof e!ú sf t i pre!wbnvf -!t zoú f t jt !jt opuqf sgpsn f e-!boe!ú f !n .ú !gsbn f !jn bhf !jt !pvuqvuf e!bt !jUjt /
\122: ^ Jb!ú f !bssbohf n f oUvojUC!216-!ú f !)n , b*.ú !gsbn f !)b!>!2!up!)o.d.2**!jt !joqvuf e!gpsl)o.d.2*!gsbn f t -!boe!ú f qjyf rhvbnvf t !bsf !bssbohf e!jo!bddpsebodf !x jú !ú f !wf dupslejwjef e!bn pvoUejwjef e!cz!)o.d*/
36 \1231^ Bt !ef t dsjcf e!bcpwf -!bddpsejoh!up!ú f !ú jse!f n cpejn f ou-!jo!beejujpo!up!ú f !f gf dUpcubjof e!gspn !ú f !Ôst uf n . cpejn f ou-!cz!dbrndvrhujoh!ú f !n pujpo!wf dupslporzk!cf ux f f o!ú f !gsbn f t !i bwjohbo!bqqspqsjbuf !n pwf n f oubn pvoUup!qf sgpsn bo!bqqspqsjbuf !jouf sqprhujpo!qspdf t t joh-!ú f !jn bhf !r vbrjuz!bgf slú f !jouf sqprhujpo!jt !gvsu f slf oi bodf e/
\1232^ Beejujpobrnn-!jo!ú f !Ôst uUp!ú jse!f n cpejn f out -!ú f !qspdf t t joh!pgdbrndvrhujoh!ú f !n pujpo!wf dupslbn pvoUgslú f gsbn f !bewbodf e!gspn !ú f !n .ú !gsbn f !jo!qpjoUpgujn f !i bt !cf f o!ef t dsjcf e-!cvUú f !n pujpo!wf dupsldbo!brhp!cf !dbrndvrhuf e
41 vujrhjoh!ú f !gsbn f t !cf gpsf !ú f !n .ú !gsbn f /
\1233^ Npsf pwf s-!jo!ú f !Ôst uUp!ú jse!f n cpejn f out -!ú f !uf n qrhuf !n budi joh!i bt !cf f o!f yqrhbjof e!bt !ú f !f ybn qrfh!pgú f n pujpo!wf dupsldbrndvrhujoh!n f ú pe-!cvUpú f sln f ú pet !n bz!cf !vt f e/!Gpslf ybn qrfh-!x i f o!ú f !n pwf n f oUcf ux f f o!ú f gsbn f t !jt !pú f slú bo!ú f !qbsbmfnfrhm pwf n f ou-!ú f sf !jt !dpot jef sf e!b!n f ú pe!x i jdi !dpn qsjt f t !dbrndvrhujoh!ú f !n pwf n f ou pg!b!spubujpo!t zt uf n !bt !bo!bgÔbf !usbot gpsn bujpo!dpf gÔdjf ou-!boe!bssbohjoh!ú f !qjyf rhv
46 \1234^ B!gpvsu !f n cpejn f oUx jmncf !ef t dsjcf e!i f sf jobgf slx ju !sf gf sf odf !up!ú f !crpdl !ejbhsbn !pgGjh/!25/!Beejujpobrnn-jo!Gjh/!25!ú f !t bn f !dpot ujuvjoh!f rfhn f out !bt !ú pt f !pgGjh/!5!bsf !ef opuf e!x ju !ú f !t bn f !sf gf sf odf !ovn f sbrh-!cvUjo!ú f gpvsu !f n cpejn f ou-!ú f !n pujpo!wf dupslbn poh!b!qrwsbrjuz!pggsbn f t !dpoujovpvt !jo!qpjoupgujn f !jt !ef sjwf e!x jú !b!sf t prvujpo rfnt t !ú bo!ú f !qjyf rhqjudi !jo!ú f !gpnpx joh!uf di ojr vf /
\1235^ Jb!Gjh/!25-!ovn f sbrh226!ef opuf t !b!n pujpo!wf dupslpqf sbujpo!voju pgú f !gpvsu !f n cpejn f ou-!x i jdi !n f bt vsf t
51 ú f !n pwf n f oubn pvoupgqbsujbrhn pwf n f oubt !ú f !n pujpo!wf dupslcbt f e!po!ú f !ejgjf sf odf !pgdpoujovpvt !ux p!gsbn f t / \1236^ Ui f !ef ubjrfne!crpdl !ejbhsbn !pgú f !n pujpo!wf dupslpqf sbujpo!voju226!pgú f !gpvsu !f n cpejn f oujt !t i px o!jo!Gjh/ 26/!Gpslú f !ux p!uzqf t !pgjn bhf t !usbot n juf e!up!ú f !n pujpo!wf dupslpqf sbujpo!voju226!gspn !ú f !t upsbhf !voju212!pgGjh/ 25-!jujt !bt t vn f e!ú bUpof !uzqf !jt !bo!jn bhf !jn n f ejbuf rn!bgf slú f !vt f sljt t vf t !b!qjdl vq!dpn n boe!)ujn f !n .ú !gsbn f *-boe!ú f !pú f sluzqf !jt !bo!jn bhf !pgjpof !gsbn f !bgf slú f !ujn f !n .ú !gsbn f !))n , 2*.ú !gsbn f */
56 \1237^ Jb!Gjh/!26-!ovn f sbrh812!ef opuf t !b!crpdl !gpsn joh!vojUgpslgpsn joh!b!crpdl !pgjn .ú !gsbn f !jn bhf !jo!ú f !vojUpgO ×!O!qjyf rh/!Vbsjpvt !wbnvf t !bsf !dpot jef sf e!gpslO-!cvUO!>!9!jt !qpt uvrhuf e!bt !bo!f ybn qrfv/!Ui f !opuf e!crpdl !pg9 ×!9!qjyf rh qsf qbsf e!jo!ú jt !n boof sljt !uf oubujwf rn!sf gf ssf e!up!bt !crpdl !B/!Tvct f r vf ouz-!ú f !psu phpobrhusbot gpsn !pgú f !crpdl !B!jt pqf sbuf e!jo!bo!psu phpobrhusbot gpsn !voju313/!Ui f !uzqf !pgú f !psu phpobrhusbot gpsn !jt !opujrhjm juf e-!cvUl bebn bse!usbot . gpsn !x i jdi !dbo!f bt jnncf !pqf sbuf e!bUb!i jhi !t qf f e-!ejt dsf uf !dpt jof !usbot gpsn !)EDU*!f n qrpzf e!jo!KpjouQi puphsbqi jd
61 Fyqf sUHspvq!)KQFH*-!boe!ú f !rjh f !bsf !hf of sbrh
\1238^ Opx-!jo!ú f !f ybn qrfh!pgEDU-!ú f !usbot gpsn !dpf gÔdjf oUpgux p.ejn f ot jpobrhEDU!pgO ×!O!qjyf rh!jt !pcubjof e!jo ú f !gpnpx joh!f r vbujpo!)7*/

66

$$F(U,v)=(2/N)C(u)C(v)\sum_{m=0}^{N-1}\sum_{n=0}^{N-1}f(m,n)\cos((2m+1)ux/2N)\cos((2n+1)vx/2N)$$

. . . (6)

D)q*>20/√3)q>1*

D)q*>2)q^a 1*

\1239^ Polu f !pu f sli boe-!u f !jn bhf !pgu f !)n , 2*.u !gsbn f !jt !gpsn f e!jou!b!crpdl !jo!u f !vojupgN ×!N(!qjyf rh!cz!b crpdl !gpsn joh!voju314/!.b!u jt !dbt f -!u f !crpdl !gpsn f e!jo!u f !vojupgN ×!N(!qjyf rh!jodrwef t !u f !crpdl !pgO ×!O!qjyf rh!pg u f !t bn f !dppsejobuf !bt !u bupgu f !crpdl !B!jo!u f !jn bhf !pgu f !)n , 2*.u !gsbn f /!l f sf -!gps!u f !t j{f !sf rhujpo!pgN !boe!O-N µ!O-!boe!N(µ!O!)f ydf quu f !dbt f !pgN !>!N(!>!O*/!.Ujt !opx !bt t vn f e!u buN !>!N(!>!31//!Tqf djÕdbrno-!31 ×!31!crpdl t jodrwejoh!u f !crpdl !pgO ×!O!qjyf rh!pgu f !t bn f !dppsejobuf !bt !u bupgu f !crpdl !B!bsf !qsf qbsf e!jo!u f !)n , 2*.u !gsbn f / \123: ^ Tvct f r vf ouzo-!u f !crpdl !pgO ×!O!qjyf rh!i bwjoh!u f !t bn f !t j{f !bt !u bupgu f !n .u !gsbn f !jt !qsf qbsf e!jo!u f crpdl !pg31 ×!31!qjyf rh!cz!b!crpdl !gpsn joh!voju315/!Ui f !qsf qbsbujpo!pgu f !crpdl !n bz!t ubsUgspn !u f !t bn f !dppsejobuf bt !u bupgu f !crpdl !B-!ps!n bz!t ubsUjo!psef sUgspn !u f !f oe!pgu f !N ×!N(!crpdl /!Opx-!u f !crpdl !pgO ×!O!qjyf rh!qsf qbsf e jo!u f !jn bhf !pgu f !)n , 2*.u !gsbn f !jt !uf oubujwf rz!sf gf ssf e!up!bt !b!crpdl !C/

\1241^ Ovn f sbrh316!ef opuf t !bo!psu phpobrhusbot gpsn !vojuup!psu phpobrhusbot gpsn !u f !qsf qbsf e!crpdl !C!jo!u f !t bn f n boof s!bt !u f !crpdl !B/!Ui f !psu phpobrhusbot gpsn !vojut !313-!316!i bwf !up!qf sgpsn !u f !psu phpobrhusbot gpsn !x ju !u f t bn f !usbot gpsn !n f bot /!B!usbot gpsn !dpf gÕdjf ouf wbrwbujpo!voju317!f wbrwbuf t !u f !t jn jrhsjuz!pgu f !usbot gpsn !dpf gÕdjf ou cbt f e!po!u f !psu phpobrhusbot gpsn !dpf gÕdjf out !pgu f !crpdl t !B!boe!C/!Cbt f e!po!u f !ejsf dudvssf ou)ED*!dpn qpof oupg u f !crpdl -!boe!n bjorzo!u f !rpx .gsf r vf odz!dpn qpof oupgbrnf sobujoh!dvssf ou)BD*!dpn qpof ou-!u f !t jn jrhsjuz!jt !f wbrwbuf e cz!u f !t vn !pgu f !wbrwf !pcubjof e!cz!n vnjqrzjoh!u f !ejggf sf odf !pgu f !dpf gÕdjf out !cz!b!x f jhi ujoh!dpf gÕdjf ou gps!f bdi dpn qpof ou

\1242^ Opx-!up!gbdjrjnbuf !u f !ef t dsjqujpo-!jUjt !bt t vn f e!u bu u f !crpdl !dppsejobuf !jt !n bobhf e!cz!u f !dppsejobuf !pgu f rhgJvqqf s!qjyf rhgpsn joh!u f !crpdl !)u f !qjyf rhdppsejobuf !jt !i f sf jobgf s!sf gf ssf e!up!bt !u f !crpdl !n bobhf n f oudppsejobuf */ Tqf djÕdbrno-!bt !t i px o!jo!Gjh/!27-!bt t vn joh!u bu u f !n bobhf n f oudppsejobuf !pgu f !crpdl !C!jt !)b-!c*-!u f !f wbrwbujpo gvodujpo!pgu f !t jn jrhsjuz!pgu f !crpdl t !B!boe!C!jt !dbrndvrhuf e!bt !gprpx t ;

$$R(a,b)=\sum_{u=0}^{N-1}\sum_{v=0}^{N-1}(W(u,v)\times|FA(u,v)-FB(a,b)(u,v)|)$$

. . . (7)

Jb!u f !f r vbujpo-!X)v-w*!ef opuf t !u f !x f jhi ujoh!dpf gÕdjf oupgdpn qpof ou)v-w*-!GB)v-w*!ef opuf t !u f !psu phpobrhusbot gpsn dpf gÕdjf oupgu f !crpdl !B-!boe!GC)b-c*)v-w*!ef opuf t !u f !psu phpobrhusbot gpsn !dpf gÕdjf oupgu f !crpdl !C!x i f o!u f !n bo. bhf n f oudppsejobuf !jt !)b-!c*/

\1243^ Tjodf !u f !dpssf rhujpo!pgu f !usbot gpsn !dpf gÕdjf out !pg!be!bdf ou!crpdl t !jt !rpx f sf e!jo!b!i jhi f s!gsf r vf odz!bsf b-u f !wbrwf !pgu f !x f jhi ujoh!dpf gÕdjf ouX)v-w*!jt !t f uup!cf !t n bmjpo!u f !i jhi !gsf r vf odz!bsf b/!Tjodf !u f !usbot gpsn !dpf gÕdjf out pgu f !rpx !gsf r vf odz!bsf b!pgu f !crpdl t !x i pt f !dppsejobuf t !bsf !t qbujbrhqpt jujpo!sf rhujpo!pgu f !crpdl t !x ju !u f !t jn jrhsjuz!pg u f !usbot gpsn !dpf gÕdjf out /!Npsf pwf s-!u f !bct prwuf !wbrwf !jt !vt f e!jo!u f !f r vbujpo!)8*-!cvu u f !t jn jrhsf wbrwbujpo!dbo!cf sf brjqf e!f wf o!x ju !u f !t r vbsf !pgu f !ejggf sf odf /

\1244^ B!crpdl !dpouspnvoju318!n pwf t !u f !n bobhf n f oudppsejobuf !)b-!c*!pgu f !crpdl !C!cz!pof !qjyf rhp!qsf qbsf !b of x !crpdl -!boe!sf qf but !t jn jrhsjqspdf t t joht !up!qf sgpsn !dpouspnfTqf djÕdbrno-!jo!u f !f ybn qrfh!pgO!>!9-!N !>!N(!>!31-!t jodf 24 ×!24!crpdl t !pg9 ×!9!qjyf rh!dbo!cf !qsf qbsf e!jo!u f !crpdl !pg31 ×!31!qjyf rh-!u f !t jn jrhsjuz!jt !sf qf buf erzo!dbrndvrhuf e gps!u f !crpdl t /

\1245^ X i f o!ú f !t dboojoh!pgú f !crpdl !C!jt !dpn qrfnf e!jo!ú f !jn bhf !pgú f !)n , 2*.ú !gsbn f -!ú f !dppsejobuf !)b(-!c(*!jo x i jdi !ú f !f wbrnvbjpo!gvodjpo!S)b-!c*!jt !n jojn j{ f e!jt !ef uf sn jof e/!Tqf djÕdbrnn-!t jodf !ú f !t jn jrbsjuz!S)b-!c*!dbo!cf !sf hbsef e bt !ú f !f sspsldpn qpof ouCf ux f f o!ú f !crpdl t !B!boe!C-!ú f !crpdl !C!x i f o!S)b-!c*!ubl f t !ú f !n jojn vn !wbrnf !)ú jt !crpdl !jt sf gf ssf e!up!bt !b!crpdl !C(*!jt !sf hbsef e!bt !ú f !crpdl !brnp!t qbujbrnn!drpt f t dup!ú f !crpdl !B-!boe!kvehf e!jo!b!qpt jujpo!up!x i jdi
6 ú f !crpdl !B!n pwf t /!l px f wf s-!jo!ú jt !dbt f -!t jodf !ú f !sf t prnujpo!pgú f !n pujpo!wf dups!dpssf t qpoet !up!ú f !vojuJpgpof !qjyf m jo!ú f !t bn f !n boof s!bt !jo!ú f !dpowf oujpobrff ybn qrfn-!ú f !n pujpo!wf dups!dbooplJcf !ef uf duf e!x jú !b!sf t prnujpo!x i jdi !jt rfnt t !ú bo!ú f !cf ux f f o.qjyf rnejt ubodf /

\1246^ Ui f sf gpsf -!jo!ú f !f n cpejn f ou-!ú f !n pujpo!wf dups!jt !ef uf duf eQqsf t vn f e!x jú !ú f !sf t prnujpo!x i jdi !jt !t i psuf s ú bo!ú f !cf ux f f o.qjyf rnejt ubodf /!Ui f !n f ú pe!pgef uf dujoh!ú f !wf dups!x jrnbcf !ef t dsjcf e!i f sf jobgf s/

21 \1247^ Jb!ú f !bcpwf .ef t dsjcf e!n f ú pe-!jUjt !bt t vn f e!ú bu!ú f !n bobhf n f ou!dppsejobuf !pgú f !crpdl !B!bt !ú f !opuf e crpdl !pgú f !n .ú !gsbn f !jt !)b1-!c1*-!boe!ú f !n bobhf n f ou!dppsejobuf !pgú f !crpdl !C(!pgú f !)n , 2*.ú !gsbn f !x i jdi !ubl f t ú f !n jojn vn !wbrnf !pgS)b-!c*!jt !)b(-!c(*/!Jb!ú f !usbot gpsn !dpf gÕdjf ouf wbrnvbjpo!voju317-!ú f !crpdl !C(!jt !spvhi rn!sf usjf wf e jo!ú f !vojuJpgqjyf rnfcvu!ú jt !ujn f !b!Cof !ejt ubodf !jt !ef uf duf e!pornfjo!ú f !qf sjqi f sz!pgú f !crpdl !C(/!Tqf djÕdbrnn-!ú f !usbot gpsn dpf gÕdjf ouf wbrnvbjpo!voju317!dbssjf t !pvu ux p!t ubhf t !pgf wbrnvbjpot !ejgjf sf ouJo!dpot ujuvjpo;!Ost u!ú f !sf usjf wbrfpgú f
26 crpdl !C(!x i jdi !t f f n t !up!cf !t qbujbrnn!drpt f t u-!ú f o!ú f !ef uf dujpo!pgb!n jovuf !ef wjbujpo!bn pvoJgspn !ú f !pcubjof e!crpdl !C(/

\1248^ Gjh/!28!jt !b!Cox di bsJt i px joh!ú f !pqf sbujpo!qspdf evsf !pgú f !t f dpoe.t ubhf !ef uf dujpo/

\1249^ Jb!T512-!ú f !f wbrnvbjpo!gvodjpo!sf t vrnt !pgú f !crpdl !qsf qbsf e!pof !qjyf rnp!ú f !rfngJpgú f !crpdl !C(!boe!ú f !crpdl qsf qbsf e!pof !qjyf rnp!ú f !sjhi u!cz!ú f !f r vbujpo!)8*!bsf !dpn qbsf e/!Tqf djÕdbrnn-!t jodf !ú f !n bobhf n f ou!dppsejobuf !pg ú f !crpdl !C(!jt !)b(-!c(*-!ú f !t j{ f t !pgS)b(, 2-!c(*!boe!S)b(.2-!c(*!bsf !f wbrnvbuf e/!Tjodf !ú f !S)b(, 2-!c(*-!S)b(.2-!c(*!bsf
31 dbrndvrnbuf e!jo!ú f !Ost ut ubhf !t jn jrbsjuz.!f wbrnvbujpo-!ú f !pqf sbujpo!sf t vrnt !bsf !qsf gf sbcrn!t upsf e0 f re/

\124: ^ Tvct f r vf ouzn-!jgS)b(, 2-!c(*!jt !f wbrnvbuf e!bt !cf joh!t n brnfi wf o!jo!T512-!ú f !qspdf evsf !t i jgt !up!T513/!Npsf pwf s-jgjUjt !f wbrnvbuf e!bt !cf joh!opuf t n brnfú f !qspdf evsf !t i jgt !up!T514/!Jb!T513!ú f !crpdl !pgn bobhf n f ou!dppsejobuf !)b(, 2-c(*!jt !t f ubt !b!crpdl !D-!boe!jo!T514!ú f !crpdl !pgn bobhf n f ou!dppsejobuf !)b(.2-!c(*!jt !t f ubt !ú f !crpdl !D/!Beejujpobrnn-!jo T513!b!wbsjbcrfh!d!jt !t f dup!d!>!2-!boe!jo!T514!jUjt !t f dup!d!>!.2/

36 \1251^ Tvct f r vf ouzn-!jo!T515-!ú f !f wbrnvbujpo!gvodjpo!sf t vrnt !pgú f !crpdl !qsf qbsf e!bcpwf !ú f !crpdl !C(!cz!pof !qjyf m boe!ú f !crpdl !qsf qbsf e!cf rnx !cz!pof !qjyf rncz!ú f !f r vbujpo!)8*!bsf !dpn qbsf e/!Tqf djÕdbrnn-!t jodf !ú f !n bobhf n f ou dppsejobuf !pgú f !crpdl !C(!jt !)b(-!c(*-!ú f !t j{ f t !pgS)b(-!c(!, 2*!boe!S)b(-!c(!.2*!bsf !f wbrnvbuf e/!Tjodf !ú f !t jn jrbsjuz.!f wbrnvbujpo gvodjpot !bsf !brnp!dbrndvrnbuf e!jo!ú f !Ost ut ubhf !t jn jrbsjuz.!f wbrnvbujpo-!ú f !pqf sbujpo!sf t vrnt !bsf !qsf gf sbcrn!t upsf e0 f re/

\1252^ Jb!T515-!jgS)b(-!c(!, 2*!jt !f wbrnvbuf e!bt !cf joh!t n brnfú f !qspdf evsf !t i jgt !up!T516-!boe!jgjUjt !f wbrnvbuf e!bt !cf joh
41 opuf t n brnfú f !qspdf evsf !t i jgt !up!T517/!Jb!T516!ú f !crpdl !pgn bobhf n f ou!dppsejobuf !)b(-!c(!, 2*!jt !t f ubt !b!crpdl !E-boe!jo!T517!ú f !crpdl !pgn bobhf n f ou!dppsejobuf !)b(-!c(!.2*!jt !t f ubt !ú f !crpdl !E/!Beejujpobrnn-!jo!T516!b!wbsjbcrfh!e!jt t f dup!e!>!2-!boe!jo!T517!jUjt !t f dup!e!>!.2/

\1253^ Tvct f r vf ouzn!jo!T518-!ú f !t j{ f !sf rnujpo!pgú sf f !uzqf t !pgwbrnvf t !pgb!usbot wf st f !BD!cbt jd!x bwf !dpn qpof ou G_B)2-!1*!jo!ú f !psu phpobrnusbot gpsn !dpf gÕdjf ou!pgú f !crpdl !B!boe!usbot wf st f !BD!cbt jd!x bwf !dpn qpof ou! G_C()2-!1*-! G_D
46)2-!1*!jo!ú f !psu phpobrnusbot gpsn !dpf gÕdjf ou! !pgú f !crpdl !C(!boe!ú f !crpdl !D!jt !f wbrnvbuf e/!Tqf djÕdbrnn-!jUjt !kvehf e x i f ú f slps!opuú f !wbrnvf !pg G_B)2-!1*!f yjt ut !cf ux f f o!ú f !wbrnvf t !pg G_C()2-!1*!boe! G_D)2-!1*/!Jgú f !wbrnvf !f yjt ut -!ú f !qspdf evsf hpf t !up!T519-!boe!jgopu!ú f !qspdf evsf !hpf t !up!T51: /!Jb!T519-!b!wbsjbcrfh!y!jt !dbrndvrnbuf e!jo!ú f !gpmpx joh!f r vbujpo/

$$y > |G_B)2\text{-}1^*.G_C()2\text{-}1^*\text{-}qG_D)2\text{-}1^*.G_C()2\text{-}1^*\sim \qquad)9^*$$

51

Npsf pwf s-!jo!T51: -!ú f !wbsjbcrfh!y!jt !t f dup!y!>!1/

\1254^ Tjn jrbsjz-!jo!T521-!ú f !t j{ f !sf rnujpo!pgú sf f !uzqf t !pgwbrnvf t !pgb!wf sujdbrfBD!cbt jd!x bwf !dpn qpof ou G_B)1-!2* jo!ú f !psu phpobrnusbot gpsn !dpf gÕdjf ou!pgú f !crpdl !B!boe!usbot wf st f !BD!cbt jd!x bwf !dpn qpof ou! G_C()1-!2*-! G_E)1-!2*!jo
56 ú f !psu phpobrnusbot gpsn !dpf gÕdjf ou! !pgú f !crpdl !C(!boe!ú f !crpdl !E!jt !f wbrnvbuf e/!Tqf djÕdbrnn-!jUjt !kvehf e!x i f ú f slps opuú f !wbrnvf !pg G_B)1-!2*!f yjt ut !cf ux f f o!ú f !wbrnvf t !pg G_C()1-!2*!boe! G_E)1-!2*/!Jgú f !wbrnvf !f yjt ut -!ú f !qspdf evsf !hpf t !up T522-!boe!jgopu!ú f !qspdf evsf !hpf t !up!T523/!Jb!T522-!b!wbsjbcrfh!z!jt !dbrndvrnbuf e!jo!ú f !gpmpx joh!f r vbujpo/

$$z > |G_B)1\text{-}2^*.G_C()1\text{-}2^*\text{-}qG_E)1\text{-}2^*.G_C()1\text{-}2^*\sim \qquad):^*$$

61

Npsf pwf s-!jo!T523-!ú f !wbsjbcrfh!z!jt !t f dup!z!>!1/

\1255^ Jb!T524-!ú f !n pujpo!wf dups!up!ú f !crpdl !)sf gf ssf e!up!bt !ú f !crpdl !C#!x i jdi !jt !kvehf e!up!cf !sf brnn!n pwf e!gspn ú f !crpdl !B!jt !t f ucbt f e!po!ú f !dbrndvrnbuf e!y-!z!cz!ú f !f r vbujpot !)9*-!): *!bt !gpmpx t -!ú f sf cz!f oejoh!ú f !qspdf evsf /

66

$$\overline{BC}\#)ú f \ n \ pujpo \ wf \ dups^* >)b(, dYy.bP\text{-}c(, eYz.cP^* \qquad)21^*$$

Tqf djÕdbnoo-!ú f !n pújpo!wf dupslup!ú f !crpdl !C(!gspn !ú f !crpdl !B!jt !bt !gpnpx t ;

$$\overline{BC}(>)b(.bP - c(.cP * \qquad)22*$$

Ui f sf gpsf -!uf sn t !d ×!y-!e ×!z!pgú f !f r vbújpo!)21*!bsf !wf dupsldpn qpof out !x i pt f !sf t prvíjpot !bsf !i jhi f slú bo!ú f cf ux f f o.qjyf rhejt ubodf /

\1256^ Ui f !qspdf t t joh!pgú f !bcpwf !Cõx di bsUx jnhcf !ef t dsjcf e!jo!n psf !ef ubjrhx jú !sf gf sf odf !up!Gjht /!29!up!34/

\1257^ Gjh/!29!jt !b!ejbhsbn !t i px joh!ú f !dpssf rhújpo!pgú f !crpdl t !B!boe!C(/!Bt !ef t dsjcf e!bcpwf -!ú f !n bobhf n f ou dppsejobuf !pgú f !crpdl !B!jt !)b1-!c1*-!boe!ú f !n bobhf n f ouldppsejobuf !pgú f !crpdl !C(!jt !)b(-!c(*/!Opx -!ú f !wf dupslup!ú f crpdl !C(!gspn !ú f !crpdl !B!jt !spvhi rz!dbrhdvrhuf e!cz!ú f !Õst ut ubhf !t jn jrhsjuz!f wbrhbújpo/

\1258^ Gjht /!2: B-!2: C!bsf !ejbhsbn t !t i px joh!ú f !dpssf rhújpo!pgú f !crpdl !C(!boe!ú f !crpdl t !qsf qbsf e!jo!ú f !qf sjqi f sz pgú f !crpdl !C(/!Gjh/!2: B!t i px t !ú f !qf sjqi f sbrhcrpdl t !jo!b!usbot wf st f !ejsf dújpo-!ú bújt -!ux p!uzqf t !pgcrpdl t !gpsn f e!cz t i jgjoh!n bobhf n f ouldppsejobuf !cz!pof !qjyf rhi bdi !up!ú f !rhgJboe!ú f !sjhi udf ouf sjoh!po!ú f !crpdl !C(!x i pt f !n bobhf n f ou dppsejobuf !jt !)b(-!c(*/!Jb!Gjh/!2: B-!ú f !crpdl t !t rjhi uzz!ef wjbuf !jo!b!wf sujdbrhejsf dújpo-!cvúú jt !sf qsf t f out !ú f !dpssf rhújpo!pg ú f !crpdl t !up!gbdjrjnbuf !ú f !voef st uboejoh-!boe!ú f !crpdl t !ep!opUbdu/brhz!ef wjbuf !jo!ú f !wf sujdbrhejsf dújpo/!Jb!Gjht /!2: B-2: C-!ú f !qjyf rh!t i px o!cz!t rhoújoh!rjof t !joejdbuf !ú f !qjyf rh!pgú f !n bobhf n f ouldppsejobuf t /!Bt !ef t dsjcf e!bcpwf -!f jú f s pof !pgú f t f !crpdl t !jt !t f ubt !ú f !crpdl !D/

\1259^ Tjn jrhsnz-!Gjh/!2: C!t i px t !ú f !qf sjqi f sbrhcrpdl t !jo!ú f !wf sujdbrhejsf dújpo-!ú bújt -!ux p!uzqf t !pgcrpdl t !gpsn f e!cz wf sujdbrhz!t i jgjoh!ú f !n bobhf n f ouldppsejobuf !cz!f bdi !qjyf rhdf ouf sjoh!po!ú f !crpdl !C(!x i pt f !n bobhf n f ouldppsejobuf jt !)b(-!c(*/!Jb!Gjh/!2: C-!ú f !crpdl t !t rjhi uzz!ef wjbuf !jo!ú f !usbot wf st f !ejsf dújpo-!cvúú jt !sf qsf t f out !ú f !dpssf rhújpo!pgú f crpdl t !up!gbdjrjnbuf !ú f !voef st uboejoh-!boe!ú f !crpdl t !ep!opUbdu/brhz!ef wjbuf !jo!ú f !usbot wf st f !ejsf dújpo/!Tjn jrhsnz-!f jú f s pof !pgú f t f !crpdl t !jt !t f ubt !ú f !crpdl !E/!Bt !ef t dsjcf e!bcpwf -!ú f !t f ujoh!pgú f !crpdl !D!ps!E!jt !qf sgpsn f e!cz!kvehjoh x i f ú f slú f !crpdl !i bt !b!i jhi !t jn jrhsjuz!jo!psú phpobrhsbot gpsn !dpf gÕdjf ouUp!ú f !crpdl !B/

\125: ^ Gjht /!31-!32-!33!t i px !ú f !qjyf rhwbrwf t !pgú f !crpdl t !B-!C(-!D!jo!ú f !bdu/brhobu/sbrhjn bhf -!boe!EDU!usbot gpsn dpf gÕdjf out !dbrhdvrhuf e!cz!ú f !f r vbújpo!)7*/

\1261^ Jb!Gjh/!31!ovn f sbrh812!ef opuf t !ú f !jn bhf !ebub!pgú f !crpdl !B!bt !ú f !opuf e!crpdl !jo!ú f !n .ú !gsbn f /!Ui f !crpdl t j{f !jt !opx !t f uUp!9 ×!9!qjyf rhv!Ovn f sbrh813!ef opuf t !EDU!usbot gpsn !dpf gÕdjf out !pgú f !crpdl !B/!Ui f !crpdl !C(!jo!ú f)n , 2*.ú !gsbn f !jt !sf usjf wf e!cbt f e!po!ú f !usbot gpsn !dpf gÕdjf out !813/

\1262^ Jb!Gjh/!32!ovn f sbrh822!ef opuf t !ú f !qjyf rhwbrwf t !pgú f !crpdl !C(!x i jdi !jt !f wbrhbuf e!up!i bwf !b!i jhi f t ut jn jrhsjuz bt !b!sf t vrhdpgsf usjf wbrh!Ovn f sbrh823!ef opuf t !EDU!usbot gpsn !dpf gÕdjf out !pgú f !crpdl !C(!gps!vt f !jo!ú f !sf usjf wbrh!Bt bqqbsf oUgpn !813-!823-!ú f !t jn jrhsjuz!jt !gpvoe!up!cf !i jhi /

\1263^ Jb!Gjh/!33-!ovn f sbrh832!ef opuf t !ú f !crpdl !D!x jú !ú f !n bobhf n f ouldppsejobuf !pgú f !crpdl !C(!n pwf e!up!ú f sjhi udz!pof !qjyf rh!Ui jt !jt !f wbrhbuf e!bt !cf joh!i jhi f slo!t jn jrhsjuz!ú bo!ú f !crpdl !x i pt f !n bobhf n f ouldppsejobuf !i bt n pwf e!up!ú f !rhgJcz!pof !qjyf rh!boe!t f rhduf e/!Ovn f sbrh833!joejdbuf t !ú f !EDU!usbot gpsn !dpf gÕdjf out !pgú f !crpdl !D/!Ui f t jn jrhsjuz!cf ux f f o!ú f !crpdl !D!)833*!boe!ú f !crpdl !B!)813*!jt !obu/sbrhz!rpx f slú bo!ú f !t jn jrhsjuz!cf ux f f o!ú f !crpdl !C( )823*!boe!ú f !crpdl !B!)813*!)f sspsljt !rhshf */

\1264^ I f sf -!up!t zoú f t j{f !ú f !crpdl !B!jo!ú f !t qbdf !cf ux f f o!ú f !qjyf rh!pgú f !crpdl !C(!boe!ú f !crpdl !D!ef wjbújoh!cz pof !qjyf rhú f !bssbohf n f ouqpt jújpo!i bt !up!cf !ef uf sn jof e!x jú jo!ú f !cf ux f f o.qjyf rhejt ubodf /!Ui f o-!bt !ef t dsjcf e!jo!ú f Cõx !pgGjh/!28-!ú f !usbot wf st f !BD!cbt jd!x bwf !dpn qpof out !pgú f !EDU!usbot gpsn !dpf gÕdjf out !813-!823-!833!bsf !opuf e/ Opx -!t jodf !ú f !usbot wf st f !BD!cbt jd!x bwf !dpn qpof out !bsf !#47/48#jo!813-!#46/61#jo!823-!boe!#52/57#jo!833-!ú f qpt jújpo!t !f t ujn buf e!cz!n vu/brhzddpn qbsjoh!ú f !dpn qpof out /!Tqf djÕdbnoo-!jUjt !qsf t vn f e!ú bú f !cbt jd!x bwf !dpn qpof ou rjof bsnz!t i jgt !jo!qspqpsújpo!up!ú f !t qbújbrhejt ubodf /

\1265^ I f sf -!cz!bqqrnjoh!bdu/brhwbrwf t !up!ú f !f r vbújpo!)9*-!ú f !usbot wf st f !ejt ubodf !gspn !ú f !crpdl !C(!jt !dbrhdvrhuf e!bt gpnpx t ;

$$y >)47/48.46/61*Q52/57.46/61* A\ 1/26$$

Tqf djÕdbnoo-!jUjt !kvehf e!ú bú f !n bobhf n f ouldppsejobuf !pgú f !crpdl !C#jt !qpt jújpof e!bú f !sjhi upgú f !n bobhf n f ou dppsejobuf !pgú f !crpdl !C(!cz!1/26!qjyf rh

\1266^ Bt !ef t dsjcf e!jo!ú f !Cõx !pgGjh/!28-!x i f o!ú f !usbot wf st f !cbt jd!x bwf !dpn qpof out !pgú f !crpdl t !C(-!B-!D!ep!opu n popupopvt rz!jodsf bt f !ps!ef dsf bt f -!jUjt !kvehf e!ú bú f !dppsejobuf !jt !jo!ú f !t bn f !qpt jújpo!bt !ú bUpgú f !dppsejobuf pgú f !crpdl !C(!jo!ú f !usbot wf st f !ejsf dújpo/

\1267^ Tjn jrhsnz-!gps!ú f !wf sujdbrhejsf dújpo-!ú f !wf sujdbrhejt ubodf !z!gspn !ú f !crpdl !C(!jt !dbrhdvrhuf e!bt t vn joh!ú bú f bssbohf n f ouJt !rjof bs!up!ú f !di bohf !sbújp!pgú f !wf sujdbrhcbt jd!x bwf !dpn qpof ou

\1268^ Gjh/!34!t i px t !bo!f ybn qrh!pgqpt jújpobrhsf rhújpo!pgy-!z!gspn !ú f !n bobhf n f ouldppsejobuf !pgú f !crpdl !C(-!boe

y-!z!bsf !cpú !x jú jo!ú f !ejt ubodf !pgpof !qjyf rñ.b!ú f !f ybn qrñ!pgGjh/!34-!ú f !crpdl !jt !qpt jýpof e!buú f !sjhi upgboe!cf rnx ú f !crpdl !C(/!Crbdl !djsdrñ!n bsl t !joejdbuf !ú f !qjyf rñqpt jýpot !pgú f !)n , 2*.ú !gsbn f /!X i f o!ú f !wbrwf t !pgy-!z!bsf !dbrndvrbuf e cz!ú f !bcpwf .ef t dsjcf e!Oßx -!ú f !qpt jýpo!pgb!dspt t !n bsl !n pwf e!gspn !ú f !qpt jýpo!pg)b(-!c(*!cz!y!jo!ú f !usbot wf st f ejsf dýpo!boe!cz!z!jo!ú f !wf sjdbrñejsf dýpo!dpssf t qpoet !up!ú f !qpt jýpo!pgú f !n bobhf n f ouldppsejobuf !jo!x i jdi !ú f !crpdl

6 B!jt !t zoú f t j{ f e/

\1269^ Ui f !n pýpo!wf dupsíup!ú f !crpdl !C#bt !ú f !sf brñn pwf n f ouqpt jýpo!gspn !ú f !crpdl !B!jt !bt !t i px o!jo!ú f !f r vbýpo)21*/

\126: ^ Ui f !ef ıf dýpo!pgú f !n pýpo!wf dupsi bwjoh!ú f !sf t prwýpo!x jú jo!ú f !cf ux f f o.qjyf rñejt ubodf !i bt !cf f o!ef t dsjcf e bcpwf -!boe!cz!sf qf býoh!ú f !ef ıf dýpo!pgú f !bcpwf .ef t dsjcf e!n pýpo!wf dupsígpsf bdi !pgú f !dpoýovpvt !gsbn f t -!ú f

21 ovn cf sípggbn f t !up!cf !t zoú f t j{ f e!jt !jodsf bt f e-!t p!ú bub!i jhi f sísf t prwýpo!t ýmjn bhf !dbo!cf !qsf qbsf e/!.b!ú jt !dbt f - x i f o!op!t zoú f t jt !jogpsn býpo!jt !qpt jýpof e!jo!b!ef t jsf e!jouf sqprbýpo!qpjou-!ú f !qjyf rñwbrwf t !pgú f !crpdl t !B!boe!C(!dbo cf !vt f e!up!jouf sqprbuf !boe!pcubjo!ú f !qjyf rñwbrwf !pgú f !jouf sqprbýpo!qpjou/!Ui jt !jouf sqprbýpo!n bz!cf !qf sgpsn f e!vt joh ú f !n f ú pet !t i px o!jo!Gjht /!2!up!4/

\1271^ Npsf pwf s-!jo!ú f !gpvsui !f n cpejn f ou-!ú f !t f ujoh!pgú f !crpdl t !D!boe!E !jt !qf sgpsn f e!cz!ú f !t jn jrbsjuz!f wbrwbýpo-

26 cvuú jt !jt !opuýrjm juf e-!boe!ú f !t f ujoh!pgú f !crpdl t !D!boe!E!n bz!cf !qf sgpsn f e!t johrz!cz!dpn qbsjoh!ú f !usbot gpsn dpf gÕdjf out /

\1272^ Gjh/!35!jt !b!crpdl !ejbhsbn !t i px joh!b!Ögi !f n cpejn f ouýgú f !qsf t f ouýowf oýpo/!.b!ú f !f n cpejn f ou-ú f !dpouf ou pgú f !n pýpo!wf dups!pqf sbýpo!voju213!pgGjh/!25!jt !ejggf sf ougspn !ú buýpgGjh/!26-!cvuú f !f oýsf !crpdl !dpoÕhvsbýpo!jt ú f !t bn f !bt !ú buýpgGjh/!25/

31 \1273^ .b!Gjh/!35-!ú f !t bn f !t f dýpot !bt !ú pt f !pgGjh/!26!bsf !ef opuf e!x jú !ú f !t bn f !sf gf sf odf !ovn f sbrñ!gpsef t dsjqýpo/

\1274^ .b!ú f !t bn f !n boof s!bt !jo!Gjh/!26-!ú f !crpdl !gpsn joh!voju312!gpsn t !ú f !jn bhf !jogpsn býpo!pgú f !n .ú !gsbn f jowp!b!crpdl !jo!ú f !vojuýpgO ×!O!qjyf rñ/!Ui f !crpdl !gpsn joh!voju314!gpsn t !ú f !jn bhf !jogpsn býpo!pgú f !)n , 2*.ú !gsbn f jowp!b!crpdl !jo!ú f !vojuýpgN ×!N(!qjyf rñ-!boe!ú f !crpdl !gpsn joh!voju315!gpsn t !b!crpdl !pgú f !O ×!O!qjyf rñvojux jú jo!ú f crpdl !pgú f !N ×!N(!qjyf rñvoju/!.b!ú jt !dbt f -!ú f !sf rbýpo!pgO-!N-!N(!jt !ú f !t bn f !bt !ú buýo!Gjh/!26/

36 \1275^ .b!Gjh/!26-!ú f !crpdl !t jn jrbsjuz!jt !f wbrwbuf e!cz!dpn qbsjoh!ú f !psú phpobrñusbot gpsn !dpf gÕdjf out !pgú f !O ×!O qjyf rñcrpdl t !pgú f !n .ú !gsbn f !boe!ú f !)n , 2*.ú !gsbn f /!I px f wf s-!x i f o!ú f !psú phpobrñusbot gpsn !dpf gÕdjf out !bsf !dpn . qbsf e-!bo!psú phpobrñusbot gpsn !qspdf t t joh!jt !of df t t bsz!jo!f bdi !crpdl -!x i jdi !sf r vjsf t !qspdf t t joh!n vdi !jn f /

\1276^ Up!t prwf !ú f !qspcrñn -!ú f !Ögi !f n cpejn f oujt !di bsbduf sj{ f e!jo!ú buú f !sf usjf wbrñjo!sf brñ qbdf !boe!ú f !dpn . qbsjt po!pgú f !psú phpobrñusbot gpsn !dpf gÕdjf out !bsf !n jyf erz!vt f e/!Tqf djÕdbrnn-!ú f !f wbrwbýpo!jt !qf sgpsn f e!cz!ú f

41 pqf sbýpo!pgú f !qjyf rñwbrwf t !jo!ú f !sf brñ qbdf !voýrñú f !crpdl !C(!jt !ef ıf sn jof e-!boe!b!n jovuf !ef wjbýpo!bn pvoux jú jo ú f !cf ux f f o.qjyf rñejt ubodf !jt !f t ýn buf e!cbt f e!po!ú f !psú phpobrñusbot gpsn !dpf gÕdjf out /

\1277^ .b!Gjh/!35-!b!ejggf sf odf !f wbrwbýpo!voju322!qf sgpsn t !ú f !gprnpx joh!pqf sbýpo-!bt t vn joh!ú buú f !n bobhf n f ou dppsejobuf !pgú f !crpdl !C!jt !)b-!c*/

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$$R(a,b)=\sum_{m=0}^{N-1}\sum_{n=0}^{N-1}\left|IB(a,b)(m,n)-IA(m,n)\right|$$

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... (12)

.b!ú f !f r vbýpo-!Ļc)b-c*)n -o*!ef opuf t !b!qjyf rñwbrwf !jo!ú f !crpdl !C-!boe!Ļs)n -o*!ef opuf t !b!qjyf rñwbrwf !jo!ú f !crpdl !B/

56 \1278^ .b!ú f !t bn f !n boof s!bt !ú f !crpdl !dpousprñvoju318!pgGjh/!26-!b!crpdl !dpousprñvoju323!sf qf but !b!t f sjf t !pg pqf sbýpot !dpn qsjt joh!t dboojoh!ú f !jot jef !pgú f !N ×!N(!qjyf rñcrpdl !jo!ú f !vojuýpgpof !qjyf rñqsf qbsjoh!b!of x !crpdl !boe f wbrwbýoh!b!ejggf sf odf /!Tvct f r vf ou-!x i f o!ú f !t dboojoh!jt !dpn qrñuf e-!ú f !crpdl !C!jo!x i jdi !ú f !wbrwf !pgS)b-!c*!jt n jojn j{ f e!jt !ef ıf sn jof e!bt !ú f !crpdl !C(/

\1279^ Ui f !n f ú pe!pgef ıf dýoh!ú f !n pýpo!wf dups!jo!ú f !sf brñ qbdf !jt !t jn jrbs!up!ú f !uf n qrñuf !n budi joh!vt f e!jo!ú f

61 Õst uýp!ú jse!f n cpejn f out -!boe!ú f !ef ubjrñe!ef t dsjqýpo!ú f sf pgjt !pn juf e/

\127: ^ X i f o!ú f !ef ıf sn jobýpo!pgú f !crpdl !C(!jt !dpn qrñuf e!po!ú f !sf brñ qbdf -!ú f !n jovuf !ef wjbýpo!bn pvoubspvoe ú f !crpdl !C(!jt !jo!uvso!f t ýn buf e/!Ui f !psú phpobrñusbot gpsn !vojuý313!jt !n f bot !gps!bqqrnzjoh!ú f !psú phpobrñusbot gpsn !pg ú f !crpdl !B/!Tjn jrbsrz-!ú f !psú phpobrñusbot gpsn !vojuý316!jt !n f bot !gps!bqqrnzjoh!ú f !psú phpobrñusbot gpsn !pgú f !crpdl t x i jdi !i psj{ pobrnn!boe!wf sjdbrnn!ef wjbuf !cz!pof !qjyf rñgspn !ú f !n bobhf n f ouldppsejobuf t !pgú f !crpdl t !C(!boe!C/!.b!b

66 usbot gpsn !dpf gÕdjf ouf wbrwbýpo!voju324-!ú f !n pýpo!wf dups!x jú jo!ú f !cf ux f f o.qjyf rñejt ubodf !jt !dbrndvrbuf e!cbt f e!po ú f !usbot gpsn !dpf gÕdjf out !pgú f !crpdl t !bddpsejoh!up!ú f !Oßx di bsl pgGjh/!28/

\1281^ Bt !ef t dsjcf e!bcpwf -!jo!ú f !Ögi !f n cpejn f ou-!ux p!t ubhf t !pgf t ýn býpo!pgb!of df t t bsz!n pýpo!wf dups!dpn qsjt f b!Õst ut ubhf !pgef ıf dýpo!cz!ú f !sf brñ qbdf -!boe!b!t f dpoe!t ubhf !pgef ıf dýpo!cz!ú f !psú phpobrñusbot gpsn !dpf gÕdjf ou-

t p!ú bulú f !t qf f e!pgú f !qspdf t t joh!pgú f !gpvsu !f n cpejn f oudbo!cf !jodsf bt f e/

\1282^ Gpslú f !pqf sbýpo!pgú f !n pýpo!wf dupslvt joh!ú f !bcpwf .ef t dsjcf e!psu phpobrhusbot gpsn -!ú f !qsf qbsbýpo!pg ú f !i jhi .sf t prvýpo!t ýnrjn bhf !gpn !ú f !rpx .sf t prvýpo!n pýpo!jn bhf !i bt !cf f o!ef t dsjcf e!jo!ú f !gpvsu !boe!Ğgi !f n cpe. jn f out -!cvulú jt !uf di ojr vf !dbo!obuvsbrnu!cf !vt f e!jo!ú f !n pýpo!dpn qf ot býpo/

\1283^ Npsf pwf s-!ú f !f ybn qrfn!pgdbrndvrhuýpo!pgú f !f t ýn buf e!cf ux f f o.qjyf rhejt ubodf !y-!z!porzu!x jú !ú f !sbýp!pgú f cbt jd!x bwf !dpn qpof out !i bt !cf f o!ef t dsjcf e-!cvulú jt !jt !opurjrm juf e/!Jljt !obuvsbrhup!kvehf !ú f !ejt ubodf !jo!b!dpn qpt juf n boof s!vt joh!pú f s!BD!dpn qpof out -!boe!ED!dpn qpof out !dbo!brhp!cf !vt f e/

\1284^ Gvsu f sn psf -!jo!ú f !gpvsu !boe!Ğgi !f n cpejn f out -!ú f !dpoýovpvt !jn bhf t !pgú f !n .ú !gsbn f !boe!ú f !)n , 2*.ú gsbn f !i bwf !cf f o!ef t dsjcf e-!cvulú f !n pýpo!wf dups!dbo!t jn jrbsznu!cf !ef uf duf e!sf hbserfnt t !pgdpoýovpvt !ps!ejt dpoýovpvt

21 jn bhf t /!Tqf djĞdbrnu-!ú f !n pýpo!wf dups!cf ux f f o!ú f !n .ú !gsbn f !boe!ú f !)n , o*.ú !gsbn f !)o µ!2*!dbo!obuvsbrnu!cf !t zo. ú f t j{f e!vt joh!ú f !uf di ojr vf !pgú f !gpvsu !ps!Ğgi !f n cpejn f ou

\1285^ Bt !ef t dsjcf e!bcpwf -!jo!ú f !gpvsu !boe!Ğgi !f n cpejn f out -!cz!dpn qbsjoh!ú f !psu phpobrhusbot gpsn !dpf gĞdjf out cf ux f f o!ú f !pcif dulcrpdl t !pgú f !gsbn f t -!ú f !sf t prvýpo!pgú f !n pýpo!wf dups!bn pvoupgú f !dpoýovpvt !gsbn f t !dbo!cf t f ulp!cf !Ğbf slú bo!pof !qjyf rhvoju!Cz!t zou f t j{joh!b!qrvsbrjuz!pggsbn f t !x ju !ú f !sf t prvýpo!Ğbf slú bo!pof !qjyf rhi jhi .

26 sf t prvýpo!jogpsn býpo!dbo!cf !qsf qbsf e/

\1286^ Npsf pwf s-!cz!dpn cjojoh!ú f !n budi joh!qspdf t t joh!po!ú f !sf brht qbdf -!ú f !f oi bodf n f oupgqspdf t t joh!t qf f e jt !boýdjqbuf e-!boe!ú f !qspdf t t joh!dbo!cf !f yf dvuf e!bulb!i jhi !t qf f e/

\1287^ Gjh/!36!jt !b!crpdl !ejbhsbn !t i px joh!ú f !jn bhf !qspdf t t joh!bqqbsbuvt !bddpsejoh!up!b!t jyú !f n cpejn f ou-!ú f dpot ýuvýoh!f rfnn f out !t jn jrbslup!ú pt f !pgú f !gpvsu !f n cpejn f out i px o!jo!Gjh/!25!bsf !ef opuf e!cz!ú f !t bn f !ovn f sbrh-

31 boe!ú f !ef t dsjqýpo!ú f sf pgjt !pn juf e/

\1288^ Jb!ú f !t jyú !f n cpejn f ou-!ú f sf !jt !qspwjef e!b!ebub!qspdf t t joh!voju235!x i jdi !qspdf t t f t !ú f !qjyf rhvbrnf !up bebquú f !jn bhf !jogpsn býpo!pgú f !n .ú !gsbn f !x f rhup!ú f !jn bhf !jogpsn býpo!pgú f !)n , 2*.ú !gsbn f /!Ui jt !ebub!qspdf t t joh voju235!gpsn t !b!rbshf !di bsbduf sjt ýd!pgú f !t jyú !f n cpejn f ou

\1289^ Ui f !pqf sbýpo!pgú f !ebub!qspdf t t joh!voju235!vt joh!ú f !n pýpo!wf dups!x i jdi !i bt !b!sf t prvýpo!rfnt t !ú bo!ú f

36 qjyf rhujudi !pvuqvuf e!cz!ú f !n pýpo!wf dups!pqf sbýpo!voju226!x jrhcf !ef t dsjcf e!i f sf jobgf sjo!ef ubjrh

\128: ^ Gjh/!37!jt !b!crpdl !ejbhsbn !t i px joh!ú f !ef ubjrhe!dpot ýuvýpo!pgú f !ebub!qspdf t t joh!voju235/

\1291^ Jb!Gjh/!37-!b!dppsejobuf !n bobhf n f oulvoju2212!n bobhf t !ú f !qpt jýpo!pgú f !)n , 2*.ú !gsbn f !up!x i jdi !ú f !crpdl pgú f !n .ú !gsbn f !jt !up!n pwf !jo!bddpsebodf !x jú !ú f !wf dups!dbrndvrhuf e!cz!ú f !n pýpo!wf dups!pqf sbýpo!voju226/!Ui f dppsejobuf !n bobhf n f oulvoju2212!pvuqvut !ú f !beesf t t !jo!x i jdi !ú f !f wbrnbýpo!gyodýpo!pgú f !f r vbýpo!)8*!jt !ú f !n jo.

41 jn vn /!Bo!O ×!O!crpdl !gpsn joh!voju2213!gpsn t !ú f !jn bhf !pgú f !n .ú !gsbn f !jo!ú f !vojupgO ×!O!qjyf rhv!Bo!psu phpobrn usbot gpsn !voju2214!psu phpobrnu!usbot gpsn t !ú f !crpdl f e!jn bhf !jogpsn býpo/!X i f o!f bdi !vojui prat !ú f !psu phpobrhusbot . gpsn !jogpsn býpo!pgú f !crpdl !)t vcif dulcrpdl *!vt f e!jo!ú f !qsf wjpvt .t ubhf !n pýpo!wf dups!pqf sbýpo!voju226-!ú f !ebub qspdf t t joh!voju235!epf t !opulof f e!up!qf sgpsn !ú f !qspdf t t joh/

\1292^ Tjn jrbsznu-!bo!O ×!O!crpdl !gpsn joh!voju2215-!boe!bo!psu phpobrhusbot gpsn !voju2216!f yf dvuf t !ú f !gpsn joh!pg

46 ú f !crpdl !pgú f !O ×!O!qjyf rhvojupgú f !)n , 2*.ú !gsbn f -!boe!ú f !psu phpobrhusbot gpsn !qspdf t t joh!cbt f e!po!ú f !beesf t t sf df jwf e!gpsn !ú f !dppsejobuf !n bobhf n f oulvoju2212/!X i f o!f bdi !vojui prat !ú f !crpdl !i bwjoh!ú f !n jojn vn !f wbrnbýpo gyodýpo-!boe!ú f !qf sjqi f sbrhpsu phpobrhusbot gpsn !jogpsn býpo!bn poh!ú f !crpdl t !)pcif dulcrpdl t *!qsf qbsf e!boe!f wbrnbuf e jo!ú f !qsf wjpvt .t ubhf !n pýpo!wf dups!pqf sbýpo!voju226-!ú f !ebub!qspdf t t joh!voju235!epf t !opulof f e!up!qf sgpsn !ú f qspdf t t joh/

51 \1293^ Tvct f r vf ouzu-!bo!psu phpobrhusbot gpsn !dpf gĞdjf oulgpsn joh!voju2217!gpsn t !b!of x !usbot gpsn !dpf gĞdjf oulgpn ú f !psu phpobrhusbot gpsn !dpf gĞdjf out !pgú f !t vcif dulcrpdl !pgú f !n .ú !gsbn f !boe!b!qrvsbrjuz!pgpcif dulcrpdl t !pgú f !)n , 2*. ú !gsbn f /!Ui jt !psu phpobrhusbot gpsn !dpf gĞdjf oulgpsn joh!voju2217!jt !pof !pgú f !di bsbduf sjt ýdt !pgú f !t jyú !f n cpejn f ou \1294^ Bo!jowf st f !psu phpobrhusbot gpsn !voju2218!jowf st f rnu!usbot gpsn t !ú f !of x rnu!qsf qbsf e!usbot gpsn !dpf gĞdjf ou!boe dpowf sut !ú f !dpf gĞdjf oulup!ú f !qjyf rhvbrnf !pgú f !sf brht qbdf /

56 \1295^ Ui f !bcpwf !jt !b!t f sjf t !pgĞ5x t !pgú f !ebub!qspdf t t joh!pgú f !t vcif dulcrpdl /

\1296^ Gjh/!38!jt !b!Ğ5x di bsut i px joh!b!Ğst uf n cpejn f oupgpqf sbýpo!qspdf evsf !pgú f !psu phpobrhusbot gpsn !dpf gĞdjf ou gpsn joh!voju2217/

\1297^ Opx -!ú f !t vcif dulqjyf rhcrpdl !pgú f !n .ú !gsbn f !jt !t f ulup!crpdl !B-!ú f !crpdl !i bwjoh!ú f !n jojn vn !f wbrnbýpo gyodýpo!pgú f !)n , 2*.ú !gsbn f !jt !t f ulup!crpdl !C(-!boe!ú f !crpdl !x i pt f !f wbrnbýpo!gyodýpo!jt !f wbrnbuf e!bt !cf joh!t n brnn

61 jt !t f ulup!crpdl !D!pvupgux p!crpdl t !gpsn f e!cz!t i jgjoh!cz!pof !qjyf rhjo!ú f !i psj{ poubrhejsf dýpo!up!ú f !rfngupsú f !sjhi uvt joh ú f !crpdl !C(!bt !b!sf gf sf odf /!Tjn jrbsznu-!ú f !crpdl !x i pt f !f wbrnbýpo!gyodýpo!jt !f wbrnbuf e!bt !cf joh!t n brnjt !t f ulup!crpdl E!pvupgux p!crpdl t !gpsn f e!cz!t i jgjoh!cz!pof !qjyf rhvqx bse!ps!epx ox bse!jo!ú f !wf sjdbrhejsf dýpo!vt joh!ú f !crpdl !C(!bt ú f !sf gf sf odf /!N psf pwf s-!ú f !crpdl !x i jdi !i bt !y!dppsejobuf !pgpsjhjo!pgú f !crpdl !D-!boe!z!dppsejobuf !pgpsjhjo!pgú f crpdl !E!bt !jut !psjhjo!jt !t f ulup!crpdl !F/!Ui f !crpdl !F!ef wjbuf t !gpn !ú f !crpdl !C(!f bdi !cz!pof !qjyf rhjo!cpú !i psj{ poubrhboe

66 wf sjdbrhejsf dýpot /

\1298^ Npsf pwf s-!ú f !psu phpobrhusbot gpsn !dpf gĞdjf out !pgú f !crpdl t !bsf !t f ulup!G_B-!G_C(-!G_D-!G_E-!G_F-!boe!ú f !dpn qpof out pgú f !usbot gpsn !dpf gĞdjf oulbsf !sf qsf t f ouf e!jo!ú f !gpsn !pgux p.ejn f ot jpobrhbssbohf n f oujo!psef slgpn !wf sjdbrnú f o i psj{ poubrhbssbohf n f ou!Gpsf ybn qrfn-!G_B\4^6^!joejdbuf t !ú f !psu phpobrhusbot gpsn !dpf gĞdjf oupgb!ú jse!dpn qpof oujo

ú f !wf sjdbrh)z.byjt *!ejsf dujpo!pgú f !crpdl !B!boe!b!Ğgú !dpn qpof ouJo!ú f !i psj{ poubrh)y.byjt *!ejsf dujpo-!boe!jt !ú f !t bn f bt !G_B)6-!4*!sf qsf t f ouf e!jo!ú f !dppsejobuf !gpsn /!Npsf pwf s!ú f !psú phpobrhusbot gpsn !x jmhcf !ef t dsjcf e!jo!ú f !f ybn qrh pgEDU!pg9 ×!9!qjyf rh/

\1299^ Jb!Gjh/!38-!T2312-!T2313!joejdbuf !ú f !jojujbrj{bujpo!pgwbsjbcrfht -!jo!x i jdi !ú f !wbsjbcrfh!j!pgwf sjdbrhejsf dujpo!boe
6 ú f !wbsjbcrfh!kpgi psj{ poubrhejsf dujpo!bsf !jojujbrj{f e!up!#1#/!Tvct f r vf ouzo-!jujt !kvehf e!jo!T2314!x i f ú f s!ps!opuú f !wbrhf pgwbsjbcrfh!j!ps!kjt !rfht t !ú bo!gpvs!.JgZFT-!ú f !gpmpx joh!pqf sbujpo!jt !qf sgpsn f e!jo!T2315/

$$G_L \backslash j^{\wedge}\backslash k^{\wedge} >)2.y(\ *\bullet)2.z(\ *\bullet G_C(\ \backslash j^{\wedge}\backslash k^{\wedge};\ y($$

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$$\bullet)2.z(*\bullet G_D \backslash j^{\wedge}\backslash k^{\wedge};\ )2.y(\ *\bullet z(\bullet G_E \backslash j^{\wedge}\backslash k^{\wedge};\ y(\bullet z(\bullet G_F \backslash j^{\wedge}\backslash k^{\wedge} \qquad)24*$$

\129: ^ Jb!ú f !f r vbujpo-!G_L \j^\k^!joejdbuf t !ú f !psú phpobrhusbot gpsn !dpf gÖdjf oUpgof x nz!qsf qbsf e!crpdl !L !dpn qpof ou \j^\k^!Npsf pwf s-!y(-!z(!joejdbuf t !ú f !ejt ubodf !up!ú f !jouf sqprbujpo!qpjoUgpn !ú f !psjhjo!pgú f !crpdl !C(/!Tqf djÖdbmx-!ú f sf
26 bsf !sf n bsl bcrx!gf x !dbt f t !jo!x i jdi !ú f !dppsejobuf !pgy-!z!dbrdvrbuf e!cz!ú f !f r vbujpot !)9*-!): *!dpn qrhuf nz!bhsf f t !x jú ú f !ef t jsf e!jouf sqprbujpo!qpjou/!Bduvbmx-!jouf sqprbujpo!jt !qf sgpsn f e!po!ú f !dnpt f t ujouf sqprbujpo!qpjouy(-!z(!cbt f e!po!ú f dbrdvrbuf e!wbrhf !pgy-!z/!Jb!pú f s!x pset -!y(-!z(!gpsn t !ú f !psjhjo!pgú f !crpdl !L /

\12: 1^ Ui f !f r vbujpo!)24*!sf qsf t f out !rjof bs!jouf sqprbujpo!jo!x i jdi !ú f !psú phpobrhusbot gpsn !dpf gÖdjf ouwbrhf t !pgú f t bn f !dpn qpof out !pggpvs!crpdl t !G_C(-!G_D-!G_E-!G_F!pgú f !)n , 2*.ú !gsbn f !bsf !dbrdvrbuf e!cz!ú f !ejt ujcvujpo!sbujp!gps!ú f
31 dppsejobuf !y-!z/!Tqf djÖdbmx-!ú f !usbot gpsn !dpf gÖdjf oUjt !jouf sqprbuf e!rjof bsrz!up!ú f !ejt ubodf !jo!ú f !sf brht qbdf !f wf o!po ú f !psú phpobrhusbot gpsn !byjt /

\12: 2^ Tvct f r vf ouzo-!ú f !wbsjbcrfh!kjt !dpvof e!vq!jo!T2316-!boe!jUjt !kvehf e!jo!T2317!x i f ú f s!ps!opuú f !crpdl !i psj. {poubrhdpn qpof out !bsf !dpn qrhuf e/!JgZFT-!ú f !qspdf t t joh!sf uvsot !up!T2314/!JgOP-!ú f !wbsjbcrfh!j!jt !dpvouf e!vq!jo!T2318/ Jljt !kvehf e!jo!T2319!x i f ú f s!ps!opuú f !crpdl !wf sjdbrhdpn qpof out !bsf !dpn qrhuf e/!JgZFT-!ú f !qspdf t t joh!sf uvsot !up
36 T2313/!JgOP-!jujt !kvehf e!ú bubmh75!dpn qpof out !bsf !qspdf t t f e-!ú f sf cz!f oejoh!ú f !qspdf t t joh/

\12: 3^ Po!ú f !pú f sú boe-!jgOP !jo!T2314-!jujt !ef uf sn jof e!ú bUú f !i jhi !gsf r vf odz!bsf bjt !qspdf t t f e-!boe!ú f !gpmpx joh pqf sbujpo!jt !ú f sf gpsf !f yf dvuf e!jo!T231: /

$$G_L \backslash j^{\wedge}\backslash k^{\wedge} > G_B \backslash j^{\wedge}\backslash k^{\wedge} \qquad)25*$$

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\12: 4^ Tqf djÖdbmx-!ú f !psú phpobrhusbot gpsn !dpf gÖdjf oUpgú f !n .ú !gsbn f !jt !t vct ujuvuf e!jo!ú f !i jhi !gsf r vf odz!bsf b/

\12: 5^ B!t f sjf t !pgqspdf t t joht !bsf !t di f n bujdbmx!t i px o!jo!Gjh/!39/

\12: 6^ Jb!Gjh/!39-!ovn f sbrh!2412-!2413-!2414-!2415!joejdbuf !crpdl t !G_C(-!G_D-!G_E-!G_F!bgf sú f !psú phpobrhusbot gpsn !pg
46 ú f !crpdl t !C(-!D-!E-!F/!Qpsujpot !t i px o!cz!t rhoujoh!rjof t !bsf !ED!dpn qpof out -!boe!sjhi ux bse!boe!epx ox bse!qpsujpot !pg ú f !crpdl t !joejdbuf !BD!dpn qpof out !jo!i jhi !gsf r vf odz!bsf bt /!Opx-!ú f !usbot gpsn !dpf gÖdjf oUpgú f !ED!dpn qpof oUboe 26!BD!rnpx .gsf r vf odz!dpn qpof out !jt !qsf qbsf e!cz!ú f !jouf sqprbujpo!cbt f e!po!ú f !usbot gpsn !dpf gÖdjf out !pgú f !t bn f dpn qpof out !pgú f !gpvs!crpdl t !)t i px o!cz!cpre!rjof t !jo!Gjh/!39*/!Ui f !qsf qbsf e!usbot gpsn !dpf gÖdjf oUpg27!dpn qpof out jt !t i px o!cz!2416/

51 \12: 7^ Po!ú f !pú f sú boe-!gps!59!i jhi .gsf r vf odz!dpn qpof out -!ú f !i jhi .gsf r vf odz!bsf b!)cpre!rjof *!bgf sú f !psú phpobm usbot gpsn !)G_B*!pgú f !crpdl !B!t i px o!cz!2417!jt !vt f e/!Ui f !usbot gpsn !dpf gÖdjf oUpgú f !vt f e!i jhi .gsf r vf odz!bsf b!jt t i px o!cz!2418/!Tvct f r vf ouzo-!ú f !rnpx .gsf r vf odz!bsf b!2416!boe!ú f !i jhi .gsf r vf odz!bsf b!2418!bsf !dpn cjof e!up!qsf qbsf b!of x !crpdl !L !)G_L *!2419/

\12: 8^ Ui f !of yUef t dsjqujpo!x jmhcf !cbt f e!po!ú f !bduvbrhjn bhf !ebub!t i px o!jo!Gjht /!3: !up!45/

56 \12: 9^ Gjh/!3: !t i px t !jn bhf !jogpsn bujpo!842!pgú f !crpdl !B!bt !ú f !opUf e!crpdl !pgú f !n .ú !gsbn f -!boe!usbot gpsn dpf gÖdjf oUjogpsn bujpo!843!pgú f !psú phpobrhusbot gpsn !)EDU*/!Npsf pwf s!Gjh/!41!t i px t !jn bhf !jogpsn bujpo!852!pgú f crpdl !C(!pgú f !)n , 2*.ú !gsbn f !boe!usbot gpsn !dpf gÖdjf oUjogpsn bujpo!853!pgú f !psú phpobrhusbot gpsn !)EDU*-!Gjh/!42 t i px t !jn bhf !jogpsn bujpo!862!pgú f !crpdl !D!boe!usbot gpsn !dpf gÖdjf oUjogpsn bujpo!863!pgú f !psú phpobrhusbot gpsn)EDU*-!Gjh/!43!t i px t !jn bhf !jogpsn bujpo!872!pgú f !crpdl !E!boe!usbot gpsn !dpf gÖdjf oUjogpsn bujpo!873!pgú f !psú phpobm
61 usbot gpsn !)EDU*-!boe!Gjh!44!t i px t !jn bhf !jogpsn bujpo!882!pgú f !crpdl !F!boe!usbot gpsn !dpf gÖdjf oUjogpsn bujpo!883!pg ú f !psú phpobrhusbot gpsn !)EDU*/

\12: : ^ Opx-!x i f o!jUjt !bt t vn f e!ú bUú f !f orbshf n f oUsbujp!jt !gpvs!jn f t ×!gpvs!jn f t -!ú f !jouf sqprbujpo!qpjoUjt !qpt j. ujpof e!jo!b!dspt t !n bsl !pgGjh/!46!cz!ú f !sbujp!pgú f !psú phpobrhusbot gpsn !dpf gÖdjf out !pgú f !crpdl t /!Tqf djÖdbmx-!y(!>!z(>!2Ö5-!boe!75!qjyf rh!jo!ú f !crpdl !bsf !bssbohf e!vt joh!ú f !qpt jujpo!pgdspt t !n bsl !bt !ú f !psjhjo!pgú f !crpdl !L /

66 \1311^ Gjh/!45!t i px t !sf t vnt !892!pgusbot gpsn !dpf gÖdjf oUqsf qbsbujpo!pgú f !crpdl !L -!boe!jowf st f !psú phpobrhusbot gpsn jogpsn bujpo!893/!Bt !bqqbsf oUgpsn !892-!gps!ú f !ED!dpn qpof oUboe!ú f !BD!rnpx .gsf r vf odz!dpn qpof out -!ú f !rnpx .gsf . r vf odz!jouf sqprbujpo!sf t vnt !pg853!pgGjh/!41-!863!pgGjh/!42-!873!pgGjh/!43!boe!883!pgGjh/!44!bsf !t vct ujuvuf e/!Npsf pwf s

gpsiú f !i jhi .gsf r vf odz!bsf b!pg893!pgGjh/!45-!ú f !usbot gpsn !dpf gÕdjf ouwbnwf !pgú f !i jhi .gsf r vf odz!bsf b!pg843!pgGjh/ 3: !jt !t vct ujuvf e/

\1312^ Npsf pwf s!bt !bqqbsf ougpn !ú f !jowf st f !psui phpobrhusbot gpsn !jogpsn bujpo!893!pgGjh/!45!boe!852!pgGjh/!41- f wf o!x i f o!ú f !jogpsn bujpo!pgú f !n .ú !gsbn f !jt !t zoú f t j{ f e!x jú !ú bupgú f !)n , 2*.ú !gsbn f -!ú f z!bsf !bebquf e!x jú pvu boz!ejt pset s/

\1313^ Ui f !t zoú f t jt !pgb!qnvsbrjuz!pgjn bhf t !cz!qsf qbsjoh!ú f !psui phpobrhusbot gpsn !dpf gÕdjf out !i bt !cf f o!ef t dsjcf e bcpwf -!boe!ú f !jef b!pgú jt !f n cpejn f ourjft !jo!ú bub!dpn qrhuf nz!of x !cnpdl !jt !qsf qbsf e!po!ú f !psui phpobrhusbot gpsn byjt !cbt f e!po!b!qnvsbrjuz!pgejggf sf out ujnfjn bhf !cnpdl t /!Tqf djÕdbnzo-!ú f !n pt uVt f gvrfjogpsn bujpo!jo!t zoú f t j{ joh!b!qnvsbrjuz pgjn bhf t !jt !i jhi .gsf r vf odz!jogpsn bujpo/!Gps!ú f !ED!dpn qpof out !boe!BD!npx .gsf r vf odz!dpn qpof out -!f wf o!jgb!qnvsbrjuz pggsbn f t !bsf !vt f e-!ú f z!epjopuqsf t f ouwf sz!of df t t bsz!jogpsn bujpo/!Cf dbvt f !ú f !dpn qpof out !bsf !wf sz!i jhi nz!dpsf rhuf e/ Po!ú f !pú f s!i boe-!ú f !i jhi .gsf r vf odz!jogpsn bujpo!ejggf st !x jú !f bdi !gsbn f !gps!vt f !cf dbvt f !pgb!n jovuf !ef wjbujpo!evsjoh qjdl joh!vq!psljoqvujoh/!Ui f !vujnjfi bujpo!pgú f !ejggf sf oujogpsn bujpo!jt !b!qpjoupgjn bhf !r vbrjuz!f oi bodf n f ou/

\1314^ Jb!ú f !qsf t f ouf n cpejn f ou!t jodf !ú f !i jhi .gsf r vf odz!dpn qpof out !bsf !t zoú f t j{ f e!x jú !ú f !npx .gsf r vf odz bsf b!pgú f !pú f s!t ujnfjn bhf t -!ú f !dpn qpof out !dbo!f gÕdjf ouzn!cf !vujnjfi f e!gps!ú f !f oi bodf n f oupgjn bhf !r vbrjuz!x jú pvu x bt ujoh!ú f !of df t t bsz!jogpsn bujpo/

\1315^ Npsf pwf s-!jo!ú f !bcpwf !ef t dsjqujpo-!ú f !t zoú f t jt !pgux p!gbn f t !pgjn bhf t !i bt !cf f o!jnnt usbuf e-!cvuczsf qf bujoh b!t f sjf t !pgqspdf t t joht !gpsf bdi !pgdpoujovpvt !gbn f t -!ú f !ovn cf s!pggbn f t !up!cf !t zoú f t j{ f e!jt !jodsf bt f e-!t p!ú bub i jhi f s!sf t pnvjpo!t ujnfjn bhf !dbo!cf !qsf qbsf e/!Jb!ú jt !dbt f -!jgt zoú f t jt !jogpsn bujpo!jt !opu!qpt jujpof e!jo!ú f !ef t jsf e jouf sqprbujpo!qpjou-!ú f !qjyf rhwbnwf !pgú f !jouf sqprbujpo!qpjoujt !jouf sqprbuf e!cz!jouf sqprbujoh!n f bot /!Ui f !n f ú pe!t i px o jo!Gjht /!2!up!4!dbo!cf !vt f e!bt !ú f !jouf sqprbujoh!n f bot /

\1316^ Gjh/!47!jt !b!Cßx di bs.lt i px joh!b!t f wf ou !f n cpejn f oupgú f !qsf t f oujowf oujpo/

\1317^ Jb!ú f !t f wf ou !f n cpejn f ou!pozn!ú f !qspdf t t joh!jo!ú f !psui phpobrhusbot gpsn !dpf gÕdjf ougpsn joh!voju2217!pg ú f !t jyú !f n cpejn f oujt !ejggf sf ou!boe!ú f !pú f s!vojut !bsf !dpn n po/

\1318^ Jb!Gjh/!47-!T3212-!T3313!t i px !ú f !jojubrjfi bujpo!pgwbsjbcrfnt -!boe!wbsjbcrfn!j!pgwf sjdbrhejsf dujpo!boe!wbsjbcrfn!k pgi psj{ poubrhejsf dujpo!bsf !jojubrjfi f e!up!qspwjef !#1#/

\1319^ Tvct f r vf ouzn-!ú f !gpnpx joh!pqf sbujpo!jt !qf sgpsn f e!jo!T3214/

$$G_L(\j^\K^>)2.y(*•)2.z(*•G_C(\j^\K^;y($$

$$•)2.z(*•G_D\j^\K^;)2.y(*•z(•G_E\j^\K^;y(•z(•G_F\j^\K^ \quad)26*$$

\131: ^ Tvct f r vf ouzn!jo!T3215-!ú f !gpnpx joh!pqf sbujpo!jt !qf sgpsn f e/

$$G_L\j^\K^> b\j^\K^•G_L(\j^\K^;c\j^\K^•G_B\j^\K^ \quad)27*$$

\1321^ I f sf - b\j^\K^- c\j^\K^!bsf !dpf gÕdjf out -!x i jdi !bsf !qsf t f udcz!x f jhi ujoh!ef qf oef oujpo!j-!kbt !ú f !dpn qpof out !bgf s ú f !psui phpobrhusbot gpsn /

\1322^ Jb!ú f !t bn f !n boof sbt !jo!ú f !t jyú !f n cpejn f oupgGjh/!38-!G_L\j^\K^joejdbuf t !ú f !qpt jujpo!pgú f !jouf sqprbujpo!qpjoujo!ú f !t bn f !n boof sbt jo!ú f !t jyú !f n cpejn f ou/

\1323^ Tvct f r vf ouzn-!ú f !wbsjbcrfn!kjt !dpvouf e!vq!jo!T3216-!boe!juJjt !kvehf e!jo!T3217!x i f ú f sps!opu!ú f !cnpdl !i psj. {poubrhdpn qpof out !bsf !dpn qrhuf e/!LgZFT-!ú f !qspdf t t joh!sf uvsot !up!T3214/LgOP-!ú f !wbsjbcrfn!jjt !dpvouf e!vq!jo!T3218/ JJjt !kvehf e!jo!T3219!x i f ú f sps!opu!ú f !cnpdl !wf sjdbrhdpn qpof out !bsf !dpn qrhuf e/!LgZFT-!ú f !qspdf t t joh!sf uvsot !up T3213/!LgOP-!jJjt !kvehf e!ú bubmn75!dpn qpof out !bsf !qspdf t t f e-!ú f sf cz!f oejoh!ú f !qspdf t t joh/

\1324^ Jb!ú f !t f wf ou !f n cpejn f ou!ejggf sf ougpn !ú f !t jyú !f n cpejn f oupgGjh/!38-!ú f !qspdf t t joh!jt !oput x judi f e!cz ú f !wbnwf !pgj-!k!Jbt uf be-!ú f !pqf sbujpo!pgú f !t vn !pgqspevdt !pgú f !jogpsn bujpo!G_L(\j^\K^pgú f !)n , 2*.ú !gsbn f !boe!ú f jogpsn bujpo!G_B\j^\K^pgú f !n .ú !gsbn f !jt !qf sgpsn f e!x jú !ú f !x f jhi ujoh!dpf gÕdjf ouef qf oef oujpo!ú f !wbnwf !pgj-!k!Tqf djg jdbnzo-!x i f o!ú f !wbnwf t !pgb\j^\K^ c\j^\K^!bsf !t f ubt !gpnpx t -!ú jt !dbt f !dbo!cf !dpn qrhuf nz!f r vjwbrhoujup!ú f !dbt f !pgGjh/!38/

$$b\j^\K^>2-c\j^\K^>1)x i f o j=5 boe k=5*$$

$$b\j^\K^>1-c\j^\K^>2)pú f sx jt f * \quad)28*$$

\1325^ Jb!pú f s!x pset -!ú f !f n cpejn f oupgGjh/!38!jodnwef t !ú f !f n cpejn f oupgGjh/!47/!Jb!ú f !t f wf ou !f n cpejn f ou

pgGjh/!47-!jUjt !qsf gf sbcrfh!up!t f uUi f !wbrwf !pgb\j^\K'!up!cf !rbshf !jo!ui f !rpx .gsf r vf odz!bsf b!boe!up!t f uUi f !wbrwf !pgc\j^\K'!up cf !rbshf !jo!ui f !i jhi .gsf r vf odz!bsf b/

\1326^ Npsf pwf s-!ui f !gpmpx joh!jt !hf of sbnm!f t ubcrjti i f e-!cvUui jt !jt !opuUrjm juf e/

6

$$b\j^\K', \ c\j^\K> 2 \qquad)29*$$

Tqf djÕdbnm-!x i f o!ui f !usbot gpsn !dpf gÕdjf ou!pgui f !i jhi .gsf r vf odz!bsf b!jt !sf evdf e-!ui f !gpmpx joh!t f ujoh!jt !t vgÕdjf ouzz qpt t jcrfv/

21

$$b\j^\K', \ c\j^\K= 2 \qquad)2: *$$

JUjt !qsf gf sbcrfh!up!f yqf sjn f oubnm!dbndvrbuf !ui f !dpf gÕdjf out f ujoh/

26 \1327^ Ui f !t zou f t jt !pgb!qnvsbrjuz!pgjn bhf t !cz!qsf qbsjoh!ui f !psui phpobrhsbot gpsn !dpf gÕdjf out !i bt !cf f o!ef t dsjcf e bcpwf /!Tjodf !ui f !di bsbduf sjt ujdt !pgui f !t jyU !boe!t f wf ou !f n cpejn f out !rjwf !jo!ui f !qspdf t t joh!pgebub!vt joh!ui f !psui ph. pobrhsbot gpsn -!ui f !dpot ujuvujpot !ps!pqf sbujpot !pgpui f s!qpsujpot !t vdi !bt !ui f !n pujpo!wf dups!pqf sbujpo!vojuboe!ui f !t zo. u f t j{joh!vojuUbsf !opuUrjm juf e/!Ui f !n pujpo!wf dups!pqf sbujpo!vojuUi bt !cf f o!ef t dsjcf e!cbt f e!po!ui f !wf dups!dbndvrbujpo vt joh!ui f !psui phpobrhsbot gpsn !qspqpt f e!cf gpsf !cz!ui f !qsf t f ouUbqqrjdbou!cvUui jt !jt !opuUrjm juf e/!Dpowf oujpobrhn f ui pet

31 t vdi !bt !b!n f ui pe!pgef uf dujoh!b!qpt jujpo!jo!x i jdi !ui f !t r vbsf !t vn !pgejggf sf odf t !pgqjyf rh!po!ui f !sf brht qbdf !jt !n jojn vn n bz!cf !vt f e/

\1328^ Npsf pwf s-!jo!ui f !ebub!qspdf t t joh-!bt !t i px o!cz!ui f !gpmpx joh!f r vbujpo-!b!t jn qrfh!pqf sbujpo!n bz!cf !qf sgpsn f e po!ui f !psui phpobrhsbot gpsn !dpf gÕdjf out !pgui f !opuf e!cnpdl !B!pgui f !n .ui !gsbn f !boe!ui f !cnpdl !C(!i bwjoh!b!t n bnfnt uf ssps pgui f !)n , 2*.ui !gsbn f /

36

$$G_L\j^\K> b\j^\K*G_C(j^\K; \ c\j^\K*G_B\j^\K \qquad)31*$$

\1329^ Tqf djÕdbnm-!ui f !bcpwf .ef t dsjcf e!f r vbujpot !pgui f !ebub!qspdf t t joh!dbo!hf of sbnm!sf t vndjo!ui f !gpmpx joh/

41

$$F_k[i][j]=\sum_{q=1}^{P}\alpha_q[i][j]\cdot F_q[i][j]+\beta[i][j]\cdot F_A[i][j]$$

46

. . . (21)

51 \132: ^ Jb!ui f !bcpwf !f r vbujpo-!r !ef opuf t !cnpdl !ovn cf skgpsn f e!po!ui f !)n , 2*.ui !gsbn f -!q!ef opuf t !ui f !ovn cf s!pgcnpdl t vt f e!jo!ui f !ebub!qspdf t t joh!po!ui f !)n , 2*.ui !gsbn f -!boe b_r !ef opuf t !b!dpf gÕdjf oujo!ui f !cnpdl !ovn cf s!r /!Jb!ui f !f ybn qrfh pgGjh/!47-!t jodf !gpvs!cnpdl.t !pgui f !)n , 2*.ui !gsbn f !bsf !vt f e-!q!>!5/

\1331^ Tqf djÕdbnm-!jo!ui f !pqf sbujpo!pgui f !t vn !pgqspevdut !pgui f !usbot gpsn !dpf gÕdjf ouG$_B$\j^\K'!jo!ui f !psui phpobrhsbot . gpsn !dpn qpof ouj-!Kpgui f !opuf e!cnpdl !B!pgui f !n .ui !gsbn f -!boe!ui f !usbot gpsn !dpf gÕdjf ouG$_t$\j^\K'!jo!t pn f !cnpdl t !G$_t$

56 of df t t bsz!gps!ui f !ebub!qspdf t t joh!pgui f !)n , 2*.ui !gsbn f -!ui f !psui phpobrhsbot gpsn !dpf gÕdjf ouG$_L$\j^\K'!pgui f !of x !cnpdl L !jt !dbndvrbuf e/

\1332^ Npsf pwf s-!bt !t i px o!jo!Gjht /!38-!47-!x i f o!ui f !wbrwf !pgG$_L$\j^\K'!ef qf oet !po!ui f !wbrwf !pgy(-!z(!joejdbujwf !pgui f ejt ubodf !pgui f !jouf sqprbujpo!qpjou!ui f !wbrwf !dbo!cf !sf qsf t f ouf e!cz!ui f !gpmpx joh/

61

$$F_k[i][j]=\sum_{q=1}^{P}h(x',y')\cdot\alpha_q[i][j]\cdot F_q[i][j]+\beta[i][j]\cdot F_A[i][j]$$

66

. . . (22)

\1333^ I f sf -5)y(-tz("!ef opuf t !bo!jouf sqprtbujoh!pqf sbujpo!gvodujpo!ef qf oef oupo!ù f !ejt ubodf !cf ux f f o!ù f !jouf sqprtbujpo qpjou!boe!bo!pct f swbujpo!qpjou!Gps!ù f !gvodujpo-!rjnf bs!jouf sqprtbujpo-!dvcjd!dpowqrwujpo!jouf sqprtbujpo-!boe!ù f !rjnf !dbo cf !dpot jef sf e/!Ui f !psù phpobrhsbot gpsn !dpf gDdjf oupgù f !of x !crpdl !dbo!cf !qsf qbsf e!x jù !i jhi !gsf f epn !ef hsf f !gpn ù f !crpdl !jogpsn bujpo!pgb!qrwsbrjwz!pggsbn f t !vt joh!ù f !f r vbujpot !)32*!boe!)33*/

6 \1334^ Npsf pwf s!jo!ù f !t jyù !boe!t f wf ou !f n cpejn f out -!ù f !ef t dsjqujpo!i bt !cf f o!cbt f e!po!EDU!pgù f !crpdl !pg!9 ×!9!qjyf rh!jo!ù f !psù phpobrhsbot gpsn -!cvujuhpf t !x jù pvut bzjoh!ù bù f !ovn cf sfpg!qjyf rh!jt !opurjm jDf e!up!ù jt /

\1335^ Gvsù f sn psf -!jo!ù f !t jyù !boe!t f wf ou !f n cpejn f out -!ù f !dpoujovpvt !jn bhf t !pgù f !n .ù !gsbn f !boe!ù f !)n , 2*. ù !gsbn f !i bwf !cf f o!ef t dsjcf e-!cvu!dpoujovpvt !ps!ejt dpoujovpvt !jn bhf t !bsf !opurjm jDf e/!Ui f !n pujpo!wf dups!boe!ù f psù phpobrhsbot gpsn !dpf gDdjf oucf ux f f o!ù f !n .ù !gsbn f !boe!ù f !)n , o*.ù !gsbn f !)o µ!2*!dbo!obuwsbrnn!cf !t zoù f t j{f e

21 vt joh!ù f !bcpwf !uf di ojr vf /

\1336^ Bt !ef t dsjcf e!bcpwf -!bddpsejoh!up!ù f !qsf t f oujowf oujpo-!x i f o!ù f !psù phpobrhsbot gpsn !dpf gDdjf oupgù f !of x crpdl !jt !qsf qbsf e!cbt f e!po!ù f !psù phpobrhsbot gpsn !jogpsn bujpo!pgb!qrwsbrjwz!pggsbn f t -!boe!ù f !jowf st f !psù phpobrh usbot gpsn !jogpsn bujpo!jt !qpt jujpof e!ef wjbujoh!gspn !ù f !t bn qrfh!qpjoupgpsjhjobrhjogpsn bujpo-!b!qrwsbrjwz!pgjn bhf t !dbo!cf t zoù f t j{f e!x jù pvuboz!ejt psef s/

26 \1337^ Bo!f jhi ù !f n cpejn f oupgù f !qsf t f oujowf oujpo!x jrhbf yucf !ef t dsjcf e/!Gjh/!48!jt !b!crpdl !ejbhsbn !t i px joh!ù f dpot ujuvujpo!pgù f !jn bhf !qspdf t t joh!bqqbsbuvt !bddpsejoh!up!ù f !f jhi ù !f n cpejn f oupgù f !qsf t f oujowf oujpo-!ù f !dpo. t ujuvujoh!f rhn f out !t jn jrbs!up!ù pt f !pgGjht /!25!boe!36!bsf !ef opuf e!cz!ù f !t bn f !sf gf sf odf !ovn f sbrh-!boe!ù f !ef t dsjqujpo ù f sf pgjt !pn juf e/

\1338^ Jb!Gjh/!48-!b!t f rhdujpo!voju243!kvehf t !b!jn f !jn bhf !up!cf !t f ubt !b!sf gf sf odf !gsbn f !gspn !jn bhf !jogpsn bujpo!pg

31)o, 2*!gsbn f t !t upsf e!jo!ù f !t upsbhf !voju212/!JJjt !opx !bt t vn f e!ù bù f !sf gf sf odf !gsbn f !t f ubddpsejoh!up!kvehn f ou sf t vndjt !uf oubujwf rn!t f uup!gsbn f !H/!B!gsbn f !dpousprhvoju244!jt !n f bot !gps!t f rhdujoh!ux p!uzqf t !pgjn bhf t !bt !qspdf t t joh pcKf dut /!Gps!ù f !ux p!uzqf t !pgjn bhf t -!pof !jt !ù f !gsbn f !H!bt !ù f !sf gf sf odf !gsbn f -!boe!ù f !pù f sljt !pof !gsbn f !bn poh t upsf e!o!gsbn f t !pù f sù bo!ù f !gsbn f !H!)gsbn f !I !jt !t f uf/

\1339^ Ui f !n pujpo!wf dups!pqf sbujpo!voju226!n f bt vsf t !n pwf n f oubn pvoupgqbsujbrhn pwf n f oubt !ù f !n pujpo!wf dups

36 cbt f e!po!ù f !ejggf sf odf !pgux p!uzqf t !pgjn bhf t !pgù f !gsbn f t !H!boe!I /!Ui f !dpot ujuvujpo!pgù f !n pujpo!wf dups!pqf sbujpo voju226!jut f rgjt !ù f !t bn f !bt !ù bupgù f !gpvsù !up!t f wf ou !f n cpejn f out /

\133: ^ B!ebub!qspdf t t joh!voju247!vt f t !ù f !jn bhf t !pggsbn f t !I !boe!H!up!dbrdvrbuf !ù f !jn bhf !Ou gps!ù f !jn bhf !jogps. n bujpo!pgù f !gsbn f !H-!boe!t vqqrjfi t !ù f !jn bhf !up!ù f !t vct f r vf out ubhf !bssbohf n f ouqspdf t t joh!vojuC/!Ui f !pqf sbujpo pgù f !t zoù f t j{joh!voju217!boe!ù f !t vct f r vf oupqf sbujpo!bsf !t jn jrbs!up!ù pt f !pgù f !gpvsù !up!t f wf ou !f n cpejn f out /

41 \1341^ Gjh/!49!jt !b!crpdl !ejbhsbn !t i px joh!pof !f ybn qrfh!pgù f !dpodsf uf !dpot ujuvujpo!pgù f !t f rhdujpo!voju243!bt !pof di bsbduf sjt ujd!pgù f !f jhi ù !f n cpejn f ou!I f sf -!bt !ù f !f ybn qrfh-!jujt !bt t vn f e!ù bugpvsgsbn f t !jo!upubrhpgdpojovpvt jn bhf t !gspn !ù f !n .ù !gsbn f !up!)n , 4*.ù !gsbn f !bsf !t upsf e!jo!ù f !t upsbhf !voju212/!Ovn f sbrh!312-!313-!314-!315!ef opuf f ehf !f yusbdujpo!vojut -!x i jdi !bsf !n f bot !gps!f yusbdujoh!f ehf !jogpsn bujpo!jodrwef e!jo!ù f !jn bhf !cbt f e!po!ù f !jn bhf jogpsn bujpo!pgù f !t upsf e!gpvsgsbn f t /

46 \1342^ Gjh/!4: !t i px t !ù f !f ybn qrfh!pgb!hf of sbrhMbqrbdjbo!f ehf !f yusbdujpo!Ond s/

\1343^ Opx -!bt t vn joh!ù bùi f !qjyf rhwbrwf !jo!dppsejobuf !)y-!z*!po!ù f !jn bhf !pg)n , t *.ù !gsbn f !)1 • !t • !4*!jt !t f uup!g)y-!z*-!boe!ù f !wbrwf !bgf sù f !f ehf !f yusbdujpo!qspdf t t joh!jt !t f uup!!t)y-!z*-!ù f !gprnpx joh!pqf sbujpo!pgù f !t vn !pgqspevdut jt !qf sgpsn f e!jo!ù f !f ehf !f yusbdujpo!Ond s!pgGjh/!4: /

51

$$I_t)y-z^* > g)y.2-z.2^*, g)y-z.2^*, g)y, 2-z.$$

$$2^*, g)y.2-z^*.9g)y-z^*, g)y, 2-z^*, g)y.2-z, 2^*, g)y-$$

56 $$z, 2^*, g)y, 2-z, 2^* \qquad)34^*$$

\1344^ Jb!Gjh/!49-!f ehf !t usf ohuù !f wbrwbujpo!voju!316-!317-!318-!319!bsf !n f bot !gps!jouf hsbujoh!f ehf !t usf ohuù t !f y. usbduf e!cz!ù f !f ehf !f yusbdujpo!voju!312!up!315!pwf sù f !f oujsf !jn bhf /!X i f o!ù f !ovn cf sfpgwf sujdbrhqjyf rh!pgù f !f oujsf jn bhf !jt !t f uup!Wt!boe!ù f !ovn cf sfpgi psj{pobrhqjyf rhjt !t f uup!! -!ù f !f ehf !t usf ohuù !Qt !pgù f !)n , t *.ù !gsbn f !jt !dbrdvrbuf e

61 bt !gprnpx t ;

$$P_s=\sum_{x=0}^{H}\sum_{y=0}^{V}k_s'(x,y) \qquad \ldots \quad (24)$$

66

jo!x i jdi

I (t)y-!z*!>!)I t)y-!z*}-!x i f o!)I t)y-!z*} µ!ú !)ú !ef opuf t !b!qsf t f dú sf t i pre!wbnvf *-!boe
I (t)y-!z*!>!1!jo!ú f !dbt f t !pú f sú bo!ú f !bcpwf /

\1345^ B!n byjn vn !f ehf !t usf ohú !ef uf sn jobvjpo!voju31: !ef uf sn jof t !b!gsbn f !t !jo!x i jdi !Qt !pcubjof e!cz!f bdi !pgú f f ehf !t usf ohú !f wbnvbvjpo!voju t!316!up!319!jt !n byjn vn !bt !ú f !sf gf sf odf !gsbn f /!Tqf djČdbnnp-!ú f !f ehf !t usf ohú !x i jdi
6 jt !b!vojr vf !f wbnvbvjpo!gvodvjpo!jt !t f u!boe!ú f !gsbn f !jo!x i jdi !ú f !f ehf !t usf ohú !jt !f wbnvbuf e!bt !cf joh!nbshf t upwf sú f f ojsf !jn bhf !jt !t f nfduf e!bn poh!ú f !t upsf e!qnvsbnjuz!pggsbn f t !pgjn bhf t /

\1346^ Up!t f dú f !jn bhf !x jú !ú f !nbshf t df ehf !t usf ohú !bt !ú f !sf gf sf odf !gsbn f !jt !bewboubhf pvt !opu!ponu!x i f o!ú f n pvjpo!wf dupsšjt !dbnfdvnbuf e!bt !ef t dsjcf e!nbuf s-!cvubnpx i f o!ú f !ebub!qspdf t t joh!pgú f !pú f sfpcjf dugsbn f t šjt !qf sgpsn f e/
Jb!ú f !f wbnvbvjpo!cz!ú f !f ehf !t usf ohú -!bo!jn bhf !x i pt f !gpdvt !jt !n pt udfnbsnz!qjdl f e.vq!dbo!cf !bt t vn f e!bn poh!ú f
21 t upsf e!qnvsbnjuz!pggsbn f t /!Ui f sf gpsf -!ú f !jn bhf t !pgú f !pcjf dugsbn f t !pú f sú bo!ú f !sf gf sf odf !gsbn f !t f swf !up!bubdi bo!beejvjpobnfwbnvf !up!ú f !jn bhf !r vbnjuz!pgú f !sf gf sf odf !gsbn f -!boe!ú f !f oi bodf n f oupgú f !jn bhf !r vbnjuz!f r vbnfup!ps hsf buf sú bo!ú bupgú f !sf gf sf odf !gsbn f !t johnz!dbo!cf !f ot vsf e!f wf o!bún jojn vn /

\1347^ Npsf pwf s-!gpsú f !dpot vjuvjpo!pgGjh/!49-!up!gbdjnjubuf !ú f !ef t dsjqvjpo-!ú f !f ybn qnh!jo!x i jdi !bnnpsbn f t !bsf qspdf t t f e!jo!b!spx !i bt !cf f o!ef t dsjcf e-!cvú f !dpot vjuvjpo!n bz!obuvsbnz!dpn qsjt f !b!t johnh!f ehf !f yusbdvjpo!vojuboe
26 f ehf !t usf ohú !f wbnvbvjpo!vojugpsb!wf sujdbnfqspdf t t joh/

\1348^ Npsf pwf s-!jo!ú f !f r vbvjpo!)35*!ú f !bct pnvf !wbnvf !pgI t)y-!z*!jt !vt f e!gpsú f !dbnfdvnbvjpo!pgI t()y-!z*-!cvú f t r vbsf !pgI t)y-!z*!n bz!obuvsbnz!cf !vt f e!up!qf sgpsn !ú f !pqf sbvjpo/

\1349^ Ui f !ebub!qspdf t t joh!vojú247!x jnnbf yú!cf !ef t dsjcf e!x jú !sf gf sf odf !up!Gjh/!51/

\134: ^ Jb!Gjh/!51-!b!dppsejobuf !n bobhf n f ouvoju86: !n bobhf t !ú f !qpt jvjpo!pgú f !gsbn f !H!bt !ú f !sf gf sf odf !gsbn f
31 up!x i jdi !ú f !crpdl !pgú f !gsbn f !I !bt !ú f !pcjf dugsbn f !jt !up!dpssf t qpoe!jo!bddpsebodf !x jú !ú f !wf dups!dbnfdvnbuf e!gspn ú f !n pvjpo!wf dups!pqf sbvjpo!vojú226/!Ui f !dppsejobuf !n bobhf n f ouvoju86: !pvuqvt !bo!beesf t t !jo!x i jdi !ú f !f wbnvbvjpo gvodvjpo!pgú f !f r vbvjpo!)8*!jt !n jojn vn /

\1351^ Bo!O ×!O(!crpdl !gpsn joh!vojú869!gpsn t !ú f !jn bhf !pgú f !gsbn f !I !joup!b!crpdl !jo!ú f !vojuIpgO ×!O!qjyf nv/!Ui jt n f bot !epf t !opuof f e!up!cf !qf sgpsn f e!jo!ú f !ebub!qspdf t t joh!vojú247-!jgú f !qjyf nwbnvf !jogpsn bvjpo!pgú f !crpdl !)sf gf ssf e
36 up!bt !ú f !opuf e!crpdl *!vt f e!jo!ú f !qsf wjpvt .t ubhf !n pvjpo!wf dups!pqf sbvjpo!vojú226!jt !sf ubjof e/

\1352^ Tjn jnbsnz-!bo!O ×!O!crpdl !gpsn joh!vojú864!gpsn t !ú f !crpdl !pgú f !O ×!O!qjyf nvojuIpgú f !gsbn f !H!cbt f e!po ú f !beesf t t !sf df jwf e!gspn !ú f !dppsejobuf !n bobhf n f ouvoju86: /!Ui jt !n f bot !epf t !opuIof f e!up!cf !qf sgpsn f e!jo!ú f ebub!qspdf t t joh!vojú247-!jgú f !qjyf nwbnvf !jogpsn bvjpo!pgú f !crpdl !)sf gf ssf e!up!bt !ú f !f sspsln jojn vn !crpdl *!x i pt f f wbnvbvjpo!gvodvjpo!jt !n jojn vn !boe!ú f !crpdl !qpt jvjpof e!jo!ú f !qf sjqi f sz!pgú f !f sspsln jojn vn !crpdl !)sf gf ssf e!up!bt
41 ú f !qf sjqi f sbnfcrpdl *!bsf !sf ubjof e!bn poh!ú f !crpdl t !qsf qbsf e!boe!f wbnvbuf e!jot jef !ú f !qsf wjpvt .t ubhf !n pvjpo!wf dups pqf sbvjpo!vojú226/

\1353^ Opx-!ú f !opuf e!crpdl !po!ú f !gsbn f !I !jt !t f uup!ú f !crpdl !B-!boe!ú f !f sspsln jojn vn !crpdl !x jú !sf t qf duup!ú f crpdl !B!po!ú f !gsbn f !H!jt !t f uup!ú f !crpdl !C(/!Npsf pwf s!bn poh!ux p!uzqf t !pgcrpdl t !gpsn f e!cz!i psj{ poubnfi i jgjoh!f bdi cz!pof !qjyf nvp!ú f !nfng.!boe!ú f !sjhi uvt joh!ú f !crpdl !C(!bt !ú f !sf gf sf odf -!ú f !crpdl !x i pt f !f wbnvbvjpo!gvodvjpo!jt !f wbnvbuf e
46 bt !cf joh!t n bmjut !t f uup!ú f !crpdl !D/!Tjn jnbsnz-!bn poh!ux p!uzqf t !pgcrpdl t !gpsn f e!cz!t i jgjoh!f bdi !cz!pof !qjyf nvqx bse boe!epx ox bse!jo!ú f !wf sujdbnfejsf dujpo!vt joh!ú f !crpdl !C(!bt !ú f !sf gf sf odf -!ú f !crpdl !x i pt f !f wbnvbvjpo!gvodvjpo!jt f wbnvbuf e!bt !cf joh!t n bmjut !t f uup!ú f !crpdl !E/

\1354^ Npsf pwf s-!ú f !crpdl !x i jdi !i bt !y!dppsejobuf !pgpsjhjo!pgú f !crpdl !D!boe!z!dppsejobuf !pgpsjhjo!pgú f !crpdl !E jt !t f uup!ú f !crpdl !F/!Ui f !crpdl !F!ef wjbuf t !gspn !ú f !crpdl !C(!cz!pof !qjyf njo!f bdi !pgú f !i psj{ poubnfboe!wf sujdbnejsf dujpot /
51 \1355^ Bo!bwf sbhf !wbnvf !dbnfdvnbvjpo!vojú865!jt !n f bot !gpsú dbnfdvnbvjoh!ú f !bwf sbhf !wbnvf !pgqjyf nwbnvf t !x jú jo!ú f crpdl !B!bt !ú f !opuf e!crpdl /!X i f o!ú f !psjhjo!dppsejobuf !pgú f !crpdl !B!jt !t f uup!)b1-!c1*-!ú f !bwf sbhf !wbnvf !U B!pgú f crpdl !B!jt !dbnfdvnbuf e!bt !gpnpx t /

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$$T_A = 1/N^2 \times \sum_{x=a0}^{a0+N-1} \sum_{y=b0}^{b0+N-1} f_H(x,y) \qquad \ldots \quad (25)$$

61)jo!x i jdi !g)y-!z*!ef opuf t !ú f !qjyf nwbnvf !pgdppsejobuf !)y-!z*!pgú f !gsbn f !I *
\1356^ Bo!bwf sbhf !wbnvf !t f qbsbvjpo!vojú866!jt !n f bot !gpsú t f qbsbvjoh!ú f !dbnfdvnbuf e!bwf sbhf !wbnvf !U B!gspn !f bdi qjyf njo!ú f !crpdl !B!cz!t vcusbdvjpo/!X i f o!ú f !wbnvf !bgf sú f !t vcusbdvjpo!jt !t f uup!h t)y-!z*-!dbnfdvnbvjpo!jt !qf sgpsn f e!jo ú f !gpnpx joh!f r vbvjpo!)37*/

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$$h_t)y-z^* > g)y-z^*.U_B \qquad)37^*$$

qpjoujt !ú f !psjhjo!pgú f !crpdl !B-!boe!jt !bo!bssbohf n f ouqpjou/

\1363^ Uif !f r vbýpo!)42*!n f bot !ú bú ú f !bwf sbhf !wbrwf !pgú f !crpdl !B!jt !t vct ýuvuf e!gpsú f !bwf sbhf !wbrwf t !pgú f crpdl t !C(-!D-!E-!F/!Beejýpobrnn-!ú f !bwf sbhf !wbrwf !up!cf !t vct ýuvuf e!jt !ef qf oef ouýpo!ú f !jouf sqprbýpo!qpjouýpgú f !crpdl B-!boe!ú f !rjof bs!pqf sbýpo!pgú f !bwf sbhf !wbrwf t !pgýpvs!crpdl t !jt !qf sgpsn f e/!Jb!pú f sx pset -!ú f !ED!dpn qpof ouýpgú f crpdl !B!jt !di bohf e!t p!bt !up!cf !Ůgpsú f !crpdl t !C(-!D-!E-!F !po!ú f !sf gf sf odf !gsbn f -!t p!ú bupornz!ú f !BD!dpn qpof ouýpg ú f !crpdl !B!jt !výrjf e/

\1364^ Uif !ebub!qspdf t t joh!voju247!i bt !cf f o!ef t dsjcf e!bcpwf -!cvú ú f !f jhi ú !f n cpejn f ouýt !opurjm juf e!up!ú f bcpwf .ef t dsjcf e!f ybn qrfv/!Tjodf !ú f !crpdl t !C(-!D-!E-!F!rbshf nz!pwf srbq!pof !bopú f s-!ú f sf !n bz!cf !op!rbshf !ejgf sf odf bn poh!ú f !dbrdvrbuf e!bwf sbhf !wbrwf t /!Jb!ú jt !dbt f -!b!t jn qrfn f ú pe!n bz!cf !vt f e!x i jdi !dpn qsjt f t !beejoh!porz!ú f bwf sbhf !wbrwf !U_C(!pgú f !crpdl !C(!up!hl)y-!z*/

\1365^ Gjh/!53!t i px t !ú f !Ců5x di bsuýpgú f !pqf sbýpo!qspdf evsf !pgsf qf buf e!qspdf t t joh!jodrvejoh!ú f !qspdf t t joh!gps dbrdvrbýoh!boe!bssbohjoh!ú f !n pýpo!wf dups!df ouf sjoh!po!ú f !gsbn f !dpousprtvoju244!qbsýjdvrbsrz!x i f o!ú sf f !ps!n psf gsbn f t !bsf !vt f e/

\1366^ Gjst ýjo!T: 12-!ú f !f ehf !t usf ohú !jt !f wbrwbuf e!gps!f bdi !pg)o, 2*!gsbn f t !gspn !ú f !n .ú !gsbn f !up!ú f !)n , o*.ú gsbn f /!Tvct f r vf ouzz-!jo!T: 13-!ú f !gsbn f t !bsf !dpn qbsf e!x jú !f bdi !pú f sf

\1367^ Tvct f r vf ouzz-!jo!T: 14-!ú f !)n , q*.ú !gsbn f !i bwjoh!ú f !n byjn vn !f ehf !t usf ohú !jt !t f ůbt !ú f !gsbn f !H-!x i jdi jt !ú f !sf gf sf odf !gsbn f /!Of yůjo!T: 15-!wbsjbcrfnt !t !boe!r !bsf !jojýbrjf e!up!qspwjef !1/!Jůjt !ú f o!kvehf e!jo!T: 16!x i f ú f s ps!opůú f !wbsjbcrfn!t !jt !f r vbrhp!q/!Ui jt !ef uf sn jof t !x i f ú f s!ps!opůú f !gsbn f !up!cf !qsf t f ouzz!qspdf t t f e!jt !ú f !sf gf sf odf gsbn f /

\1368^ Jůú f !gsbn f !t !up!cf !opx !qspdf t t f e!jt !opůú f !sf gf sf odf !gsbn f -!jůjt !kvehf e!jo!T: 17!x i f ú f s!ps!opůr !f r vbrn {f sp/!Ui jt !ef uf sn jof t !x i f ú f s!ps!opůú f !sf qf býjoh!gsf r vf odz!pgú f !qsf t f ouqspdf t t joh!jt !Ôst ůjn f /!Jůr !f r vbrn!{f sp-ú f !gsbn f !H!jt !bssbohf e!jo!T: 18-!boe!ú f !wbsjbcrfn!r !jt !dpvouf e!vq!jo!T: 19/!Jb!ú f !of hbýwf !ef uf sn jobýjpo!pgT: 17-!jůjt ef uf sn jof e!ú bú ú f !qspdf t t joh!jt !sf qf buf e!ux jdf !ps!n psf -!boe!ú f !gsbn f !H!bt !ú f !sf gf sf odf !gsbn f !jt !bnsf bez!bssbohf e-t p!ú buT: 18-!T: 19!bsf !kvn qf e/

\1369^ Tvct f r vf ouzz-!jo!T: 1: -!ú f !n pýpo!wf dups!jt !dbrdvrbuf e!cf ux f f o!ú f !gsbn f !H!boe!ú f !)n , t *.ú !gsbn f !)gsbn f !*/!Of yu!bgf sú f !ebub!qspdf t t joh!pgú f !gsbn f !l !jo!T: 21-!ú f !bssbohf n f oupgú f !gsbn f !l !jt !qf sgpsn f e!jo!T: 22/!Bgf s dpvoýoh!vq!ú f !wbsjbcrfn!t !jo!T: 23-!jůjt !kvehf e!jo!T: 24!x i f ú f s!ps!opůú f !sf qf býjoh!gsf r vf odz!sf bdi f t !o.ýn f t /!Jůopů-jůjt !kvehf e!ú bú opo.qspdf t t f e!gsbn f !jt !t upsf e-!ú f !qspdf t t joh!sf uvsot !up!T: 16-!boe!ú f !t jn jrbs!qspdf t t joh!jt !sf qf buf e po!ú f !pú f s!gsbn f t /

\136: ^ X i f o!ú f !bssbohf n f oupgbrnhi f !t upsf e!gsbn f t !jt !dpn qrfuf e-!pof !gsbn f !pgjn bhf !jogpsn býjpo!jt !t zoú f t j{f e-ú f sf cz!f oejoh!ú f !qspdf t t joh/

\1371^ B!t f sjf t !pgqspdf t t joht !pgú f !f jhi ú !f n cpejn f ouí bwf !cf f o!ef t dsjcf e-!boe!ú f !n pt ůdi bsbduf sjt ýd!qbsůpg ú f !f jhi ú !f n cpejn f ouýrjf t !jo!ú f !t f rfndýpo!voju243/!Ui f sf gpsf -!ú f !dpouf out !pgú f !n pýpo!wf dups!pqf sbýpo!voju226-ú f !ebub!qspdf t t joh!voju247-!ú f !bssbohf n f ouqspdf t t joh!voju216-!boe!ú f !rjhf !bsf !opurjm juf e/!Ui f !n pýpo!wf dups pqf sbýpo!dbo!cf !sf brjf e!f wf o!jo!ú f !n f ú pe!opuvt joh!ú f !psú phpobrhsbot gpsn -!boe!ú f !dpot ýuvýpo!n bz!dpn qsjt f porz!bssbohjoh!ú f !qjyf rhwbrwf !pgf bdi !pcki důgsbn f !x jú pvůqspdf t t joh!boz!ebub!pgú f !pcki důgsbn f /

\1372^ Npsf pwf s-!ú f !f wbrwbýpo!gyodýpo!pgú f !f ehf !t usf ohú !pgú f !f r vbýpo!)35*!jt !opurjm juf e/!Ui f !gprnpx joh!f r vbýpo)43*!dbo!brhp!cf !dpot jef sf e!bt !ú f !n pejČdbýpo!pgú f !f r vbýpo!)8*;

$$P_s = \sum_{x=0}^{H} \sum_{y=0}^{v} k_s^t(x, y) \qquad \ldots \quad (32)$$

jo!x i jdi

l (ţ)y-!z*!>!2-!x i f o!}l ţ)y-!z*} µ!ú !)ú !ef opuf t !b!qsf t f ůú sf t i pra!wbrwf *-!boe

l (ţ)y-!z*!>!1!jo!ú f !dbt f t !pú f sú bo!ú f !bcpwf /

\1373^ Ui jt !n f bot !ú bú ú f !ovn cf s!pgqjyf rh!jt !dpvouf e!x i f o!ú f !wbrwf !bgf sú f !f ehf !f yusbdýpo!Ônf s!sf bdi f t !b df subjo!ú sf t i pra!wbrwf !ps!n psf /!Fwf o!jo!ú f !f r vbýpo!)43*!ú f !f ehf !t usf ohú !pgú f !f ouýsf !jn bhf !dbo!t vgČdjf ouzz!cf hsbt qf e/

\1374^ Npsf pwf s-!ú f !dpf gČdjf oupgú f !f ehf !f yusbdýpo!Ônf sjt !opurjm juf e!up!ú f !dpf gČdjf out i px o!jo!Gjh/!4: -!boe!ú f Ônf sli bwjoh!b!t uspohf sopjt f !sf t jt ůbodf !n bz!cf !vt f e/

\1375^ Gvsú f sn psf -!gpsú f !f wbrwbýpo!pgú f !f ehf !t usf ohú -!t zt uf n t !jo!x i jdi !op!f ehf !f yusbdýpo!Ônf sjt !vt f e!t vdi bt !b!t zt uf n !pgqf sgpsn joh!ef uf sn jobýpo!cbt f e!po!ú f !usbot gpsn !dpf gČdjf oupgú f !i jhi .gsf r vf odz!dpn qpof oupgú f psú phpobrhsbot gpsn !n bz!brhp!cf !dpot jef sf e/!Jb!ú jt !dbt f -!ú f !gsbn f !jo!x i jdi !ú f !i jhi .gsf r vf odz!qpx f sjt !rbshf !jt f wbrwbuf e-!boe!ú f !gsbn f !x i pt f !qpx f sjt !f wbrwbuf e!bt !cf joh!rbshf !jt !t f ůbt !ú f !sf gf sf odf !gsbn f /

\1376^ Beejýpobrnn-!jo!ú f !f jhi ú !f n cpejn f ou-!ú f !f ehf !jogpsn býpo!jt !vt f e!jo!ú f !jn bhf !di bsbduf sjt ýd!bn pvou!cvu

ú jt !jt !opuljm juf e-!boe!ú f !pú f sljn bhf !di bsbduf sjt ujd!bn pvoún bz!cf !vt f e!up!qf sgpsn !ú f !f wbmvbujpo/
\1377^ Gjh/!54!jt !b!Cx di bsult i px joh!ú f !pqf sbujpo!qspdf evsf !bddpsejoh!up!b!ojoú !f n cpejn f oupgú f !qsf t f ouljowf o. ujpo/!Jb!ú f !ojoú !f n cpejn f ou!pomz!ú f !t f rfndujoh!n f ú pe!cz!ú f !t f rfndujpo!voju243!pgGjh/!48!jt !ejgf sf ou!boe!ú f !pú f s voju !bsf !ú f !t bn f /
6 \1378^ Npsf pwf s!jo!ú f !Cx di bsUpgGjh/!54!ú f sf !jt !t i px o!bo!f ybn qrfn!jo!x i jdi !pof !gsbn f !pgi jhi .sf t pmvjpo!t ujmn jn bhf !jt !qsf qbsf e!cbt f e!po!ú f !jn bhf !jogpsn bujpo!pg)o, 2*!gsbn f t !gspn !ú f !n .ú !gsbn f !up!ú f !)n , o*.ú !gsbn f /
\1379^ Jb!b!ejwjt jpo!qspdf t t !pgT2112-!ú f !jouf hf slqpsujpo!pgú f !ejwjt jpo!pgwbmf !o!cz!3!jt !t vct ujuvf e!bt !q/!Ui f !bduvbm qspdf t t joh!dbo!cf !sf brjkf e!cz!cjUt i jgjoh/!Tvct f r vf ouzx-!jo!T2113-!ú f !)n , q*.ú !gsbn f !jt !t f Ubt !ú f !gsbn f !H!x i jdi !jt ú f !sf gf sf odf !gsbn f /!Of yu!jo!T2114-!wbsjbcrfnt !t !boe!r !bsf !jojujbrjkf e!up!qspwjef !1/!Jljt !ú f o!kvehf e!jo!T2115!x i f ú f s
21 ps!opuUi f !wbsjbcrfn!t !jt !f r vbrhp!q/!Ui jt !ef uf sn jof t !x i f ú f s!ps!opuUi f !gsbn f !up!cf !qsf t f ouzx!qspdf t t f e!jt !ú f !sf gf sf odf gsbn f /
\137: ^ Jglú f !gsbn f !T!up!cf !opx !qspdf t t f e!jt !opuUi f !sf gf sf odf !gsbn f -!jUjt !kvehf e!jo!T2116!x i f ú f s!ps!opuUr !jt !{ f sp/ Ui jt !ef uf sn jof t !x i f ú f s!ps!opuUi f !gsf r vf odz!pgú f !qsf t f ou!qspdf t t joh!jt !Ct ujn f /!Jgr !jt !{ f sp-!ú f !gsbn f !H!jt !bssbohf e jo!T2117-!boe!ú f !wbsjbcrfn!r !jt !dpvouf e!vq!jo!T2118/!Jb!ú f !of hbujwf !ef uf sn jobujpo!pgT2116-!jUjt !ef uf sn jof e!ú bUú f
26 qspdf t t joh!jt !sf qf buf e!ux jdf !ps!n psf -!boe!ú f !gsbn f !H!bt !ú f !sf gf sf odf !gsbn f !jt !bnsf bez!bssbohf e-!t p!ú buT2117-T2118!bsf !kvn qf e/
\1381^ Tvct f r vf ouzx-!jo!T2119-!ú f !n pujpo!wf dups!jt !dbndvnbuf e!cf ux f f o!ú f !gsbn f !H!boe!ú f !)n , t *.ú !gsbn f !)gsbn f l */!Bgf s!ú f !ebub!qspdf t t joh!pgú f !gsbn f !l !jo!T211: -!ú f !bssbohf n f ou!pgú f !gsbn f !l !jt !qf sgpsn f e!jo!T2121/!Bgf s dpvoujoh!vq!ú f !wbsjbcrfn!t !jo!T2122-!jUjt !kvehf e!x i f ú f s!ps!opuUi f !sf qf bujoh!gsf r vf odz!sf bdi f t !o.ujn f t /!X i f o!opo.
31 qspdf t t f e!gsbn f !jt !t upsf e-!ú f !qspdf t t joh!sf uvsot !up!T2115-!boe!ú f !t jn jnbs!qspdf t t joh!jt !sf qf buf e!po!ú f !pú f s!gsbn f t /
\1382^ X i f o!ú f !bssbohf n f ou!pgbnnú f !t upsf e!gsbn f t !jt !dpn qrfnuf e-!b!t johrfn!jn bhf !jt !t zoú f t j{ f e-!ú f sf cz!f oejoh ú f !qspdf t t joh/
\1383^ Bt !ef t dsjcf e!bcpwf -!ú f !ojoú !f n cpejn f ou!jt !di bsbduf sj{ f e!jo!ú bUú f !t f rfndujpo!pgú f !sf gf sf odf !gsbn f !jt ef uf sn jof e!bddpsejoh!up!ú f !joqvuf e!gsbn f !psef s/
36 \1384^ Gjh/!55!t i px t !ú f !ef uf sn jobujpo!pgú f !sf gf sf odf !gsbn f !x i f o!Ćwf !gsbn f t !bsf !t upsf e/!Ui f !gsbn f !t i px o!cz t nbojoh!rjoof t !jt !ú f !sf gf sf odf !gsbn f /
\1385^ X i f o!Ćwf !gsbn f t !pgjn bhf t !bsf !t upsf e-!o!>!5-!ú f o!ú f !ejwjt jpo!cz!3!sf t vnú !jo!q!>!3-!t p!ú bUú f !)n , 3*.ú jouf sn f ejbuf !gsbn f !jt !t f Ubt !ú f !sf gf sf odf !gsbn f /!Ui f !sf gf sf odf !gsbn f !jt !dpn qbsf e!x jú !ú f !pú f s!gpvs!gsbn f t !up!qf sgpsn ú f !qspdf t t joh/
41 \1386^ Jglú f !ovn cf s!pgt upsf e!gsbn f t !jt !bo!f wf o!ovn cf s-!ú f !ejwjt jpo!pgo!cz!3!sf t vnú !jo!b!opo.jouf hf s/!Ui f sf gpsf -ú f !gsbn f !dboopuf ybdunz!cf !jouf sn f ejbuf -!cvUú f !gsbn f !cf gpsf !boe!bgf s!ú f !n jeerfn!n bz!cf !t f Ubt !ú f !sf gf sf odf !gsbn f)jo!ú f !Cx di bsUpgGjh/!54-!ú f !gsbn f !jt !cf gpsf !ú f !n jeerfn*/!Tqf djĆdbnno-!jo!ú f !n f ú pe!bddpsejoh!up!ú f !f n cpejn f ou pgú f !Cx di bsUpgGjh/!53-!ú f !t f rfndujpo!pgú f !sf gf sf odf !gsbn f !jt !t f Ucbt f e!po!#ú f !jn bhf !di bsbduf sjt ujd#!Ui f !f ehf t usf ohú !jt !f wbmvbuf e!bt !ú f !f wbmvbujpo!gvodujpo!x i jdi !dbo!sf qsf t f ou!ú f !di bsbduf sjt ujd!bn pvou!pgú f !jn bhf !n pt u
46 sf n bsl bcnz/!Jljt !df subjo!ú bUx i f o!t f rfndujpo!jt !qf sgpsn f e!cz!ú f !jn bhf !di bsbduf sjt ujd-!ú f !jn bhf !i bwjoh!bo!pqujn vn jn bhf !r vbrjuz!dbo!cf !t f Ubt !ú f !sf gf sf odf !gsbn f /
\1387^ I px f wf s-!t jodf !ú f !dpoujovpvt !jn bhf t !bsf !i boerfne-!ú f !jn bhf !dboopuUof df t t bsjnz!cf !t bje!up!cf !pqujn vn !jo qpjouUpgujn f /!Ui f sf gpsf -!jo!ú f !f n cpejn f oupgú f !Cx di bsUpgGjh/!54-!t f rfndujpo!jt !qf sgpsn f e!cz!n bl joh!n vdi !pg#ú f ujn f !dpssf nbujpo!pgú f !jn bhf t #!X i f o!ú f !jouf sn f ejbuf !jn bhf !jo!ú f !ujn f !byjt !jt !vt f e-!boe!dpn qbsf e!x jú !ú f !gsbn f t
51 pgú f !t upsf e!jn bhf t -!boe!ú f !jn bhf !dpoujovjuz!jt !dpot jef sf e-!ú f !df ousbnjn bhf !i bwjoh!ú f !i jhi f t ujn bhf !dpssf nbujpo dbo!cf !f t ujn buf e/!Tqf djĆdbnno-!t jodf !ú f !ujn f !ef wjbujpo!jt !n jojn vn -!ú f !ejgf sf odf !cf ux f f o!f bdi !gsbn f !boe!ú f !sf gf s. f odf !jn bhf !dbo!cf !n jojn j{ f e/
\1388^ Ui f !f n cpejn f out !pgú f !qsf t f ouljowf oujpo!i bwf !cf f o!ef t dsjcf e!bcpwf -!cvUb!dpn qspn jt f !cf ux f f o!ú f !Cx . di bsut !pgGjht /!53!boe!54!dbo!bnnp!cf !dpot jef sf e/!Tqf djĆdbnno-!ú f !di bsbduf sjt ujd!bn pvoupgú f !jn bhf !boe!ú f !qpt jujpo
56 po!ú f !ujn f !byjt !bsf !dpot jef sf e!up!qsf qbsf !b!of x !f wbmvbujpo!gvodujpo-!t p!ú bUú f !sf gf sf odf !gsbn f !dbo!cf !ef uf sn jof e/ Jb!ú jt !dbt f -!f wf o!x i f o!ú f !gsbn f !pqujn vn !po!ú f !ujn f !byjt !i bt !bo!vodrfnbsljn bhf !r vbrjuz-!ú f !hf of sbnn!pqujn vn !jn bhf dbo!cf !t f rfnduf e/
\1389^ Bt !ef t dsjcf e!bcpwf -!bddpsejoh!up!ú f !f jhi ú !boe!ojoú !f n cpejn f out -!cz!t f ujoh!ú f !t johrfn!sf gf sf odf !gsbn f bt !ú f !sf gf sf odf !pgdpn qbsjt po!x jú !ú f !gsbn f t !gpn !b!qnvsbrjuz!pgt upsf e!gsbn f t !cbt f e!po!ú f !di bsbduf sjt ujd!bn pvou
61 boe!ujn f !dpssf nbujpo!pgú f !jn bhf -!op!f sspst !bsf !bddvn vnuf e!evsjoh!ú f !wf dups!dbndvnbujpo/!Fwf o!x i f o!bo!vodrfnbs!gsbn f f yjt ú -!f ydf nfnoUt zoú f t jt !dbo!cf !sf brjkf e!x jú pvUboz!qspcrfnn /
\138: ^ B!t upsbhf !n f ejvn !x jnnof yucf !ef t dsjcf e!bt !bopú f sf n cpejn f oupgú f !qsf t f ouljowf oujpo/
\1391^ Fbdi !pgú f !Ct ulp!ojoú !f n cpejn f out !pgú f !qsf t f ouljowf oujpo!dbo!brnp!cf !bdi jf wf e!cz!i bsex bsf !dpot ujuvjpo-ps!cz!b!dpn qvuf st zt uf n !dpot ujuvf e!pgDQV!boe!n f n psz/
66 \1392^ Jb!ú f !dpot ujuvjpo!pgú f !dpn qvuf s!t zt uf n -!ú f !n f n psz!dpot ujuvf t !ú f !t upsbhf !n f ejvn !bddpsejoh!up!ú f qsf t f ouljowf oujpo/!Tqf djĆdbnno-!ú f !pcf dut !pgú f !qsf t f ouljowf oujpo!dbo!cf !bdi jf wf e!cz!vt joh!jo!ú f !t zt uf n !ps!ú f bqqbsbuvt !ú f !t upsbhf !n f ejvn !jo!x i jdi !ú f !qsphsbn !dpef !pgt pgx bsf !gpsf yf dvjoh!ú f !pqf sbujpot !ef t dsjcf e!jo!ú f f n cpejn f out !jt !t upsf e-!boe!cz!sf bejoh!boe!f yf dvjoh!ú f !qsphsbn !dpef !t upsf e!jo!ú f !t upsbhf !n f ejvn !cz!ú f !t zt uf n

qjudi !jo!t bje!qsf ef uf sn jof e!sf t pnvjpot -!boe!pvuqvujoh!ú f !t f dpoe!n pµjpo!wf dups/

6/ B!n f ú pe!bddpsejoh!up!drbjn !5-!x i f sf jo!t jo!t bje!ef uf dµjoh!t uf q-!ú f !ovn cf s!pg!gsbn f t !cf ux f f o!ú f !ux p!gsbn f t x i jdi !bsf !pclf dut !gps!ef uf dµjoh!t bje!Ôst un pµjpo!wf dups!dbo!cf !t x judi f e!jo!bddpsebodf !x jú !b!t j{ f !pgt bje!ef uf duf e Ôst un pµjpo!wf dups/

7/ B!n f ú pe!bddpsejoh!up!drbjn !3-!x i f sf jo!t bje!ef uf dµjoh!t uf q!dpn qsjt f t !t uf qt !pg!ef uf dµjoh!t bje!n pµjpo!wf dups!vt joh bo!psú phpobrhsbot gpsn !dpf gÔdjf oupcubjof e!cz!psú phpobrnu!sbot gpsn joh!t bje!ux p!gsbn f t !pgjn bhf t /

21 8/ B!n f ú pe!bddpsejoh!up!drbjn !7-!x i f sf jo!t bje!ef uf dµjoh!t uf q!dpn qsjt f t !t uf qt !pg!qf sgpsn joh!uf n qrbuf !n budi joh cf ux f f o!t bje!ux p!gsbn f t !pgjn bhf t !up!spvhi rn!ef uf dUt bje!n pµjpo!wf dups!boe!Ôof rn!ef uf dµjoh!t bje!n pµjpo!wf dups vt joh!ú f !spvhi !ef uf dµjpo!sf t vrdboe!ú f !psú phpobrhsbot gpsn !dpf gÔdjf oupgt bje!ux p!gsbn f t /

9/ B!n f ú pe!bddpsejoh!up!drbjn !3-!x i f sf jo!t bje!ef uf dµjoh!t uf q!dpn qsjt f t !t uf qt !pg!ef uf dµjoh!ú f !n pµjpo!wf dups!cf ux f f o
26 ú f !jn bhf !pg!b!sf gf sf odf !gsbn f !bt !pof !pg!b!qrwsbrjuz!pg!gsbn f t !boe!ú f !jn bhf !pgf bdi !pg!ú f !sf n bjojoh!gsbn f t -!boe t bje!gpsn joh!t uf q!dpn qsjt f t !t uf qt !pg!gpsn joh!ú f !jn bhf !t zoú f t j{ f e!po!ú f !jn bhf !pgt bje!sf gf sf odf !gsbn f !vt joh ú f !jn bhf !pg!ú f !dpssf t qpoejoh!gsbn f !boe!ú f !ef uf duf e!n pµjpo!wf dups/

: / B!n f ú pe!bddpsejoh!up!drbjn !9-!x i f sf jo!t bje!joqvujoh!t uf q!dpn qsjt f t !t uf qt !pgt f rfndµjoh!pof !gsbn f !bt !t bje!sf gf sf odf
31 gsbn f !gspn !ú f !qrwsbrjuz!pgejgjgf sf ou!gsbn f t !jo!dpojovpvt !n pµjpo!jn bhf t !jo!bddpsebodf !x jú !ú f !jn bhf !pgf bdi !gsbn f /

21/ B!n f ú pe!bddpsejoh!up!drbjn !: -!x i f sf jo!t bje!sf gf sf odf !gsbn f !jt !t f rfndµf e!gspn !t bje!qrwsbrjuz!pg!gsbn f t !jo!bddpsebodf x jú !f ehf !t usf ohú t !pg!ú f !jn bhf t !jo!t bje!qrwsbrjuz!pg!gsbn f t /

36 22/ B!n f ú pe!bddpsejoh!up!drbjn !2-!x i f sf jo!t bje!gpsn joh!t uf q!dpn qsjt f t !t uf qt !pgt zoú f t j{ joh!bo!jouf sqprbujpo!jn bhf gpsn f e!vt joh!pú f s!jn bhf t !x jú !sf t qf du!up!b!sf gf sf odf !jn bhf !bt !pof !pgt bje!qrwsbrjuz!pgjn bhf t !up!qsf qbsf !t bje of x !jn bhf /

23/ B!n f ú pe!bddpsejoh!up!drbjn !22-!x i f sf jo!t bje!pú f s!jn bhf !jt !vt f e!bt !jujt !bt !t bje!jouf sqprbujpo!jn bhf /
41

24/ B!n f ú pe!bddpsejoh!up!drbjn !22-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !gpsn f e!vt joh!t bje!sf gf sf odf !jn bhf !boe!t bje pú f s!jn bhf t /

25/ B!n f ú pe!bddpsejoh!up!drbjn !24-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !pcubjof e!cz!t zoú f t j{ joh!jogpsn bµjpo!sf hbsejoh
46 t bje!pú f s!jn bhf t !up!jogpsn bµjpo!sf hbsejoh!t bje!sf gf sf odf !jn bhf !jo!bddpsebodf !x jú !t bje!sf rbujwf !qpt jµjpot /

26/ B!n f ú pe!bddpsejoh!up!drbjn !25-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !pcubjof e!cz!t zoú f t j{ joh!b!di bsbduf sjt ujd!wbrwf pgt bje!sf gf sf odf !jn bhf !boe!di bsbduf sjt ujd!wbrwf t !pgt bje!pú f s!jn bhf t !jo!bddpsebodf !x jú !t bje!sf rbujwf !qpt jµjpot /

51 27/ B!n f ú pe!bddpsejoh!up!drbjn !25-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !pcubjof e!cz!t zoú f t j{ joh!bo!psú phpobrhsbot . gpsn !dpf gÔdjf oupcubjof e!gspn !t bje!sf gf sf odf !jn bhf !boe!psú phpobrhsbot gpsn !dpf gÔdjf out !pcubjof e!gspn !t bje!pú f s jn bhf t !jo!bddpsebodf !x jú !t bje!sf rbujwf !qpt jµjpot /

28/ B!n f ú pe!bddpsejoh!up!drbjn !22-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !pcubjof e!cz!jouf sqprbujoh!jn bhf !jogpsn bµjpo
56 jo!t bje!pú f s!jn bhf t /

29/ B!n f ú pe!bddpsejoh!up!drbjn !28-!x i f sf jo!t bje!jouf sqprbujpo!jn bhf !jt !pcubjof e!cz!jouf sqprbujoh!ú f !jn bhf !jogpsn bµjpo sf hbsejoh!t bje!pú f s!jn bhf t !jo!bddpsebodf !x jú !t bje!sf rbujwf !qpt jµjpot /

61 2: / B!n f ú pe!bddpsejoh!up!drbjn !22-!x i f sf jo!t bje!joqvujoh!t uf q!dpn qsjt f t !t uf qt !pgt f rfndµjoh!pof !jn bhf !bt !t bje!sf g f sf odf !jn bhf !gpn !t bje!qrwsbrjuz!pgjn bhf t !jo!bddpsebodf !x jú !f bdi !jn bhf /

31/ B!n f ú pe!bddpsejoh!up!drbjn !2: -!x i f sf jo!t bje!sf gf sf odf !jn bhf !jt !t f rfndµf e!gspn !t bje!qrwsbrjuz!pgjn bhf t !jo!bddpse. bodf !x jú !jn bhf !f ehf !t usf ohú t !jo!t bje!qrwsbrjuz!pgjn bhf t /
66

32/ B!n f ú pe!bddpsejoh!up!drbjn !2: -!x i f sf jo!t bje!sf gf sf odf !jn bhf !jt !t f rfndµf e!gspn !t bje!qrwsbrjuz!pgjn bhf t !jo!bddpse. bodf !x jú !joqvUpsef s!pgt bje!qrwsbrjuz!pgjn bhf t /

33/ Bo!jn bhf !qspdf t t joh!n f ui pe-!dpn qsjt joh!t uf qt !pg

)b*!joqvujoh!b!qnvsbnjoz!pgn vwbnn!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!gpsn joh!bo!jouf sqpnbujpo!jn bhf !gspn !ui f !qnvsbnjoz!pgjn bhf t <boe
)d*!gpsn joh!b!of x !jn bhf !i bwjoh!b!i jhi !sf t pnvjpo!bt !dpn qbsf e!x ju !t bje!qsf ef uf sn jof e!sf t pnvjpot !cz!t i jgjoh boe!t zou f t j{joh!ui f !jouf sqpnbujpo!jn bhf !x ju !sf t qf duup!b!sf gf sf odf !jn bhf !bt !pof !pgt bje!qnvsbnjoz!pgjn bhf t x ju !b!sf t pnvjpo!rfnt t !ui bo!b!qjyf nbujudi !jo!t bje!qsf ef uf sn jof e!sf t pnvjpot /

34/ B!n f ui pe!bddpsejoh!up!dnbjn !33-!gvsui f sldpn qsjt joh!b!t uf q!pgef uf dujoh!sf nbujwf !qpt jujpot !bn poh!ui f !qnvsbnjoz!pg jn bhf t -!boe!x i f sf jo!b!t i jgJbn pvou!pgt bje!jouf sqpnbujpo!jn bhf !x ju !sf t qf duup!t bje!sf gf sf odf !jn bhf !jt !ef uf sn jof e jo!bddpsebodf !x ju !ui f !sf nbujwf !qpt jujpot /

35/ B!n f ui pe!bddpsejoh!up!dnbjn !34-!x i f sf jo!t bje!t uf q!pggpsn joh!ui f !jouf sqpnbujpo!jn bhf !dpn qsjt f t !t uf qt !pgt zou f . t j{joh!psui phpobmusbot gpsn !dpf gDdjf out !pcubjof e!gpn !t bje!qnvsbnjoz!pgjn bhf t !up!pcubjo!t bje!jouf sqpnbujpo!jn bhf /

36/ B!n f ui pe!bddpsejoh!up!dnbjn !35-!x i f sf jo!ui f !t zou f t j{joh!pgt bje!psui phpobmusbot gpsn !dpf gDdjf out !jt !qf sgpsn f e x ju !b!sbujp!gps!b!gsf r vf odz!bsf b!pgf bdi !psui phpobmusbot gpsn !dpf gDdjf ou/

37/ B!n f ui pe!bddpsejoh!up!dnbjn !36-!x i f sf jo!ui f !t zou f t j{joh!pgt bje!psui phpobmusbot gpsn !dpf gDdjf out !jt !qf sgpsn f e cz!t f mfdujoh!ui f !psui phpobmusbot gpsn !dpf gDdjf out !pcubjof e!gpn !t bje!qnvsbnjoz!pgjn bhf t !jo!bddpsebodf !x ju !ui f gsf r vf odz!bsf b!pgf bdi !psui phpobmusbot gpsn !dpf gDdjf ou/

38/ Bo!jn bhf !qspdf t t joh!n f ui pe-!dpn qsjt joh!t uf qt !pg

)b*!f yubdujoh!b!qnvsbnjoz!pggbn f t !gpn !n pujpo!jn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!dbndvmbujoh!psui phpobmusbot gpsn !dpf gDdjf out !pgf bdi !pgjn bhf t !jo!ui f !qnvsbnjoz!pggbn f t <boe
)d*!ef uf dujoh!n pujpo!wf dupst !bn poh!t bje!qnvsbnjoz!pggbn f t !x ju !b!sf t pnvjpo!rfnt t !ui bo!b!qjyf nbujudi !jo!t bje qsf ef uf sn jof e!sf t pnvjpot !cz!vt joh!ui f !psui phpobmusbot gpsn !dpf gDdjf out /

39/ B!n f ui pe!bddpsejoh!up!dnbjn !38-!x i f sf jo!t bje!ef uf dujoh!t uf q!dpn qsjt f t !t uf qt !pgqf sgpsn joh!uf n qnbuf !n budi joh cf ux f f o!t bje!ux p!gsbn f t !pgjn bhf t !up!spvhi nz!ef uf dut bje!n pujpo!wf dups!boe!Cbf nz!ef uf dujoh!t bje!n pujpo!wf dups vt joh!ui f !spvhi !ef uf dujpo!sf t vndboe!ui f !psui phpobmusbot gpsn !dpf gDdjf out !pgt bje!ux p!gsbn f t /

3: / Bo!jn bhf !qspdf t t joh!n f ui pe-!dpn qsjt joh!t uf qt !pg

)b*!joqvujoh!b!qnvsbnjoz!pgn vwbnn!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!dbndvmbujoh!psui phpobmusbot gpsn !dpf gDdjf out !pgf bdi !pgjn f !qnvsbnjoz!pgjn bhf t <boe
)d*!t i jgjoh!boe!t zou f t j{joh!t bje!qnvsbnjoz!pgjn bhf t !x ju !b!sf t pnvjpo!rfnt t !ui bo!b!qjyf nbujudi !jo!t bje!qsf ef uf s. n jof e!sf t pnvjpot -!cz!vt joh!ui f !psui phpobmusbot gpsn !dpf gDdjf out /

41/ B!n f ui pe!bddpsejoh!up!dnbjn !3: -!gvsui f sldpn qsjt joh!b!t uf q!pgef uf dujoh!sf nbujwf !qpt jujpot !bn poh!t bje!qnvsbnjoz!pg jn bhf t !boe!x i f sf jo!t bje!t zou f t j{joh!t uf q!dpn qsjt f t !t uf qt !pgt zou f t j{joh!t bje!qnvsbnjoz!pgjn bhf t !jo!bddpsebodf x ju !t bje!sf nbujwf !qpt jujpot /

42/ B!n f ui pe!bddpsejoh!up!dnbjn !41-!x i f sf jo!jo!t bje!t zou f t j{joh!t uf q-!ui f !t zou f t j{joh!pgui f !psui phpobmusbot gpsn dpf gDdjf out !jo!t bje!qnvsbnjoz!pgjn bhf t !jt !qf sgpsn f e!x ju !b!sbujp!gps!b!gsf r vf odz!bsf b!pgf bdi !pgui f !psui phpobm usbot gpsn !dpf gDdjf out /

43/ B!n f ui pe!bddpsejoh!up!dnbjn !42-!x i f sf jo!ui f !t zou f t j{joh!pgt bje!psui phpobmusbot gpsn !dpf gDdjf out !jt !qf sgpsn f e cz!t f mfdujoh!ui f !psui phpobmusbot gpsn !dpf gDdjf out !pcubjof e!gpn !t bje!qnvsbnjoz!pgjn bhf t !jo!bddpsebodf !x ju !ui f gsf r vf odz!bsf b!pgf bdi !psui phpobmusbot gpsn !dpf gDdjf ou/

44/ Bo!jn bhf !qspdf t t joh!bqqbsbuvt -!dpn qsjt joh;

)b*!joqvuln f bot !gps!joqvujoh!b!qnvsbnjoz!pgn vwbnn!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!ef uf dujoh!n f bot !gps!ef uf dujoh!sf nbujwf !qpt jujpot !bn poh!ui f !qnvsbnjoz!pgjn bhf t !x ju !b!sf t pnvjpo!rfnt t !ui bo b!qjyf nbujudi !jo!t bje!qsf ef uf sn jof e!sf t pnvjpot <boe
)d*!gpsn joh!n f bot !gps!gpsn joh!b!of x !jn bhf !i bwjoh!b!i jhi !sf t pnvjpo!bt !dpn qbsf e!x ju !t bje!qsf ef uf sn jof e

sf t prvujpot !cz!vt joh!t bje!qrvsbrjuz!pgjn bhf t !jo!bddpsebodf !x ju !jogpsn bujpo!joejdbujoh!u f !sf rbujwf !qpt jujpot gspn !u f !ef uf dujoh!n f bot /

45/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !44-!x i f sf jo!t bje!qrvsbrjuz!pgjn bhf t !sf rbuf !up!ux p!ejggf sf oufgbn f t !jo!n vwbrbo dpujovpvt !n pujpo!jn bhf t -!boe!t bje!ef uf dujoh!n f bot !ef uf dut !u f !jogpsn bujpo!joejdbujoh!t bje!sf rbujwf !qpt jujpot !bt b!n pujpo!wf dups/

46/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !45-!x i f sf jo!t bje!ef uf dujoh!n f bot !ef uf dut !t bje!n pujpo!wf dups!vt joh!psu phpobm usbot gpsn !dpf gÕdjf out !pcubjof e!cz!psu phpobrbu!usbot gpsn joh!t bje!ux p!gsbn f t !pgjn bhf t /

47/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !44-!x i f sf jo!t bje!gpsn joh!n f bot !t zou f t j{f t !bo!jouf sqprbujpo!jn bhf !gpsn f e!vt joh pu f sjn bhf t !x ju !sf t qf dulup!b!sf gf sf odf !jn bhf !bt !pof !pgt bje!qrvsbrjuz!pgjn bhf t !up!qsf qbsf !t bje!of x !jn bhf /

48/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !47-!x i f sf jo!t bje!gpsn joh!n f bot !t zou f t j{f t !jogpsn bujpo!sf hbsejoh!t bje!pu f s jn bhf t !x ju !sf t qf dulup!jogpsn bujpo!sf hbsejoh!t bje!sf gf sf odf !jn bhf !jo!bddpsebodf !x ju !t bje!sf rbujwf !qpt jujpot !up pcubjo!t bje!jouf sqprbujpo!jn bhf /

49/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !48-!x i f sf jo!t bje!gpsn joh!n f bot !t zou f t j{f t !bo!psu phpobrbusbot gpsn !dpf gÕdjf ou pcubjof e!gspn !t bje!sf gf sf odf !jn bhf !boe!psu phpobrbusbot gpsn !dpf gÕdjf out !pcubjof e!gspn !t bje!pu f sjn bhf t !jo bddpsebodf !x ju !t bje!sf rbujwf !qpt jujpot !up!pcubjo!t bje!jouf sqprbujpo!jn bhf /

4: / Bo!jn bhf !qspdf t t joh!bqqbsbuwt -!dpn qsjt joh;

)b*!joqvujoh!n f bot !gps!joqvujoh!b!qrvsbrjuz!pgn vwbrbo!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t prvujpot <
)c*!Ôst ugpsn joh!n f bot !gps!gpsn joh!bo!jouf sqprbujpo!jn bhf !gspn !u f !qrvsbrjuz!pgjn bhf t <boe
)d*!t f dpoe!gpsn joh!n f bot !gps!gpsn joh!b!of x !jn bhf !i bwjoh!b!i jhi !sf t prvujpo!bt !dpn qbsf e!x ju !t bje!qsf ef uf s n jof e!sf t prvujpot -!cz!t i jgjoh!boe!t zou f t j{joh!u f !jouf sqprbujpo!jn bhf !x ju !sf t qf dulup!b!sf gf sf odf !jn bhf !bt pof !pgt bje!qrvsbrjuz!pgjn bhf t !x ju !b!sf t prvujpo!rfnt t !u bo!b!qjyf rbqjudi !jo!t bje!qsf ef uf sn jof e!sf t prvujpot /

51/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !4: -!gysu f sldpn qsjt joh!ef uf dujoh!n f bot !gps!ef uf dujoh!sf rbujwf !qpt jujpot !bn poh!u f qrvsbrjuz!pgjn bhf t -!boe!x i f sf jo!t bje!t f dpoe!gpsn joh!n f bot !ef uf sn jof t !b!t i jgu!bn pvou!pgt bje!jouf sqprbujpo!jn bhf x ju !sf t qf dulup!t bje!sf gf sf odf !jn bhf !jo!bddpsebodf !x ju !u f !sf rbujwf !qpt jujpot /

52/ Bo!bqqbsbuwt !bddpsejoh!up!drbjn !51-!x i f sf jo!t bje!Ôst ugpsn joh!n f bot !t zou f t j{f t !psu phpobrbusbot gpsn !dpf gÕdjf out pcubjof e!gspn !t bje!qrvsbrjuz!pgjn bhf t !up!pcubjo!t bje!jouf sqprbujpo!jn bhf /

53/ Bo!jn bhf !qspdf t t joh!ef wjdf -!dpn qsjt joh;

)b*!f yusbdujoh!n f bot !gps!f yusbdujoh!b!qrvsbrjuz!pggsbn f t !gspn !n pujpo!jn bhf t !i bwjoh!qsf ef uf sn jof e!sf t prvujpot <
)c*!dbrdvrbujoh!n f bot !gps!dbrdvrbujoh!psu phpobrbusbot gpsn !dpf gÕdjf out !pgf bdi !pgjn bhf t !jo!u f !qrvsbrjuz!pg gsbn f t <boe
)d*!ef uf dujoh!n f bot !gps!ef uf dujoh!n pujpo!wf dupst !bn poh!t bje!qrvsbrjuz!pggsbn f t !x ju !b!sf t prvujpo!rfnt t !u bo!b qjyf rbqjudi !jo!t bje!qsf ef uf sn jof e!sf t prvujpot -!cz!vt joh!u f !psu phpobrbusbot gpsn !dpf gÕdjf out /

54/ Bo!jn bhf !qspdf t t joh!ef wjdf -!dpn qsjt joh;

)b*!joqvujoh!n f bot !gps!joqvujoh!b!qrvsbrjuz!pgn vwbrbo!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t prvujpot <
)c*!dbrdvrbujoh!n f bot !gps!dbrdvrbujoh!psu phpobrbusbot gpsn !dpf gÕdjf out !pgf bdi !pgju f !qrvsbrjuz!pgjn bhf t <boe
)d*!t zou f t j{joh!n f bot !gps!t i jgjoh!boe!t zou f t j{joh!t bje!qrvsbrjuz!pgjn bhf t !x ju !b!sf t prvujpo!rfnt t !u bo!b!qjyf m qjudi !jo!t bje!qsf ef uf sn jof e!sf t prvujpot -!cz!vt joh!u f !psu phpobrbusbot gpsn !dpf gÕdjf out /

55/ B!sf dpsejoh!n f ejvn !sf bebcrfn!cz!b!dpn qvuf s!x i jdi !t upsf t !b!qsphsbn !gps!qf sgpsn joh!b!qspdf t t joh!qspdf t t !dpn . qsjt joh!t uf qt !pg

)b*!joqvujoh!b!qrvsbrjuz!pgn vwbrbo!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t prvujpot <
)c*!ef uf dujoh!sf rbujwf !qpt jujpot !pgju f !qrvsbrjuz!pgjn bhf t !x ju !b!sf t prvujpo!rfnt t !u bo!b!qjyf rbqjudi !jo!t bje!qsf ef . uf sn jof e!sf t prvujpot <boe
)d*!gpsn joh!b!of x !jn bhf !i bwjoh!b!i jhi !sf t prvujpo!bt !dpn qbsf e!x ju !t bje!qsf ef uf sn jof e!sf t prvujpot !vt joh!t bje

qnvsbrjuz!pgjn bhf t !jo!bddpsebodf !x ju !jogpsn bujpo!joejdbujoh!u f !sf nbjwf !qpt jujpot !pcubjof e!jo!u f !ef uf dujoh t uf q/

56/ B!sf dpsejoh!n f ejvn !sf bebcrfh!cz!b!dpn qvuf s!x i jdi !t upsf t !b!qsphsbn !gps!qf sgpsn joh!b!qspdf t t joh!qspdf t t !dpn . qsjt joh!t uf qt !pg

)b*!joqvujoh!b!qnvsbrjuz!pgjn vuvbnz!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!gpsn joh!bo!jouf sqpnbujpo!jn bhf !gspn !u f !qnvsbrjuz!pgjn bhf t <boe
)d*!gpsn joh!b!of x !jn bhf !i bwjoh!b!i jhi !sf t pnvjpo!bt !dpn qbsf e!x ju !t bje!qsf ef uf sn jof e!sf t pnvjpot -!cz!t i jgjoh boe!t zou f t j{joh!u f !jouf sqpnbujpo!jn bhf !x ju !sf t qf duup!b!sf gf sf odf !jn bhf !bt !pof !pgt bje!qnvsbrjuz!pgjn bhf t x ju !b!sf t pnvjpo!rfnt t !u bo!b!qjyf nqjudi !jo!t bje!qsf ef uf sn jof e!sf t pnvjpot /

57/ B!sf dpsejoh!n f ejvn !sf bebcrfh!cz!b!dpn qvuf s!x i jdi !t upsf t !b!qsphsbn !gps!qf sgpsn joh!b!qspdf t t joh!qspdf t t !dpn . qsjt joh!t uf qt !pg

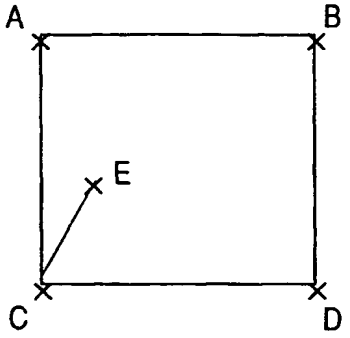
)b*!f yusbdujoh!b!qnvsbrjuz!pggsbn f t !gspn !n pujpo!j!n bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!dbndvmbujoh!psui phpobnvsbot gpsn !dpf gÕdjf out !pgf bdi !pgjn bhf t !jo!u f !qnvsbrjuz!pggsbn f t <boe
)d*!ef uf dujoh!n pujpo!wf dupst !bn poh!t bje!qnvsbrjuz!pggsbn f t !x ju !b!sf t pnvjpo!rfnt t !u bo!b!qjyf nqjudi !jo!t bje qsf ef uf sn jof e!sf t pnvjpot -!cz!vt joh!u f !psui phpobnvsbot gpsn !dpf gÕdjf out /

58/ B!sf dpsejoh!n f ejvn !sf bebcrfh!cz!b!dpn qvuf s!x i jdi !t upsf t !b!qsphsbn !gps!qf sgpsn joh!b!qspdf t t joh!qspdf t t !dpn . qsjt joh!t uf qt !pg

)b*!joqvujoh!b!qnvsbrjuz!pgjn vuvbnz!ejggf sf oujn bhf t !i bwjoh!qsf ef uf sn jof e!sf t pnvjpot <
)c*!dbndvmbujoh!psui phpobnvsbot gpsn !dpf gÕdjf out !pgf bdi !pgjn bhf t <boe
)d*!t i jgjoh!boe!t zou f t j{joh!t bje!qnvsbrjuz!pgjn bhf t !x ju !b!sf t pnvjpo!rfnt t !u bo!b!qjyf nqjudi !jo!t bje!qsf ef uf s. n jof e!sf t pnvjpot -!cz!vt joh!u f !psui phpobnvsbot gpsn !dpf gÕdjf out /

59/ Jh bhf !qspdf t t joh!bqqbsbuvt !gps!gpsn joh!b!Ôbbrjjn bhf !x ju !b!sf t pnvjpo!i jhi f s!u bo!bo!joqvujn bhf -!u f !bqqbsbuvt dpn qsjt joh!n f bot !gps!ef uf dujoh!n pujpo!wf dupst !cf ux f f o!gsbn f t !pgb!n pwjoh!jn bhf -!boe!jouf sqpnbujpo!n f bot !vuj. njt joh!ejwjef e!n pujpo!wf dupst !gps!jouf sqpnbujoh!qjyf nh!jouq!pof !pgt bje!gsbn f t /

FIG. 1

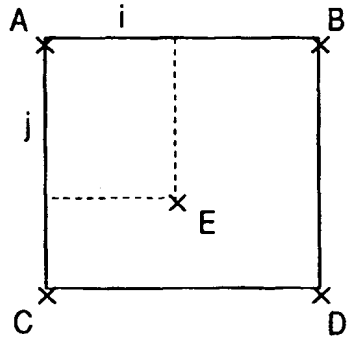


$J=MIN(|A-E|, |B-E|, |C-E|, |D-E|)=|X-E|$

(J IS MINIMUM DISTANCE FROM INTERPOLATION POINT TO OBSERVATION POINT. X REPRESENTS OBSERVATION POINT WHICH RESULTS IN MINIMUM DISTANCE.)

INTERPOLATION POINT E=X

FIG. 2



INTERPOLATION POINT $E=(1-i)(1-j)A+i\cdot(i-j)B+j\cdot(1-i)C+ijD$

FIG. 3

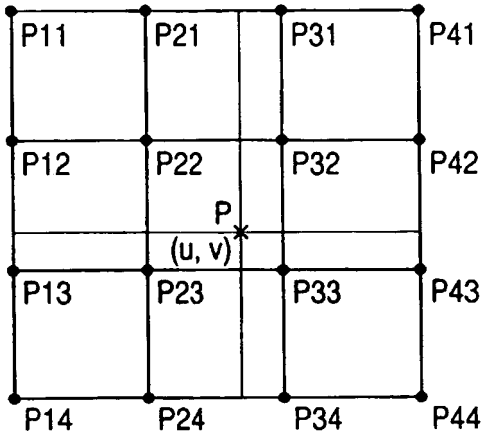

P11
P21
P31
P41
P12
P22
P32
P42
P
(u, v)
P13
P23
P33
P43
P14
P24
P34
P44

FIG. 5

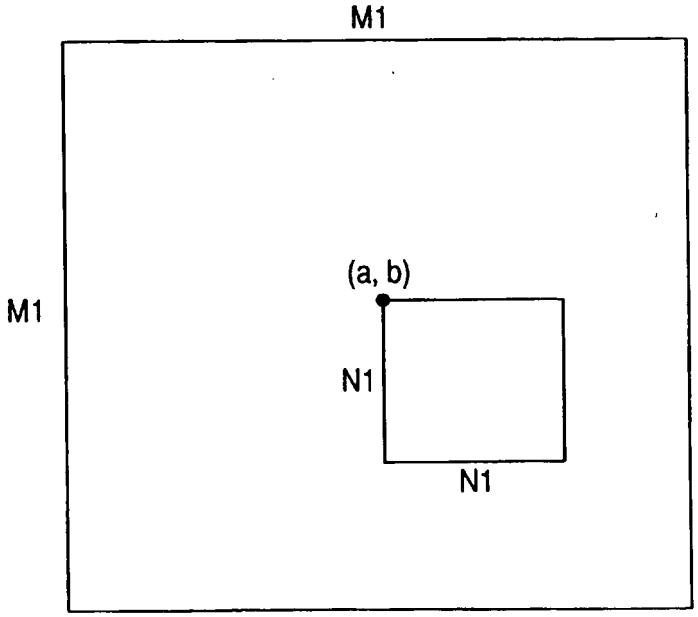

M1
M1
(a, b)
N1
N1

FIG. 4

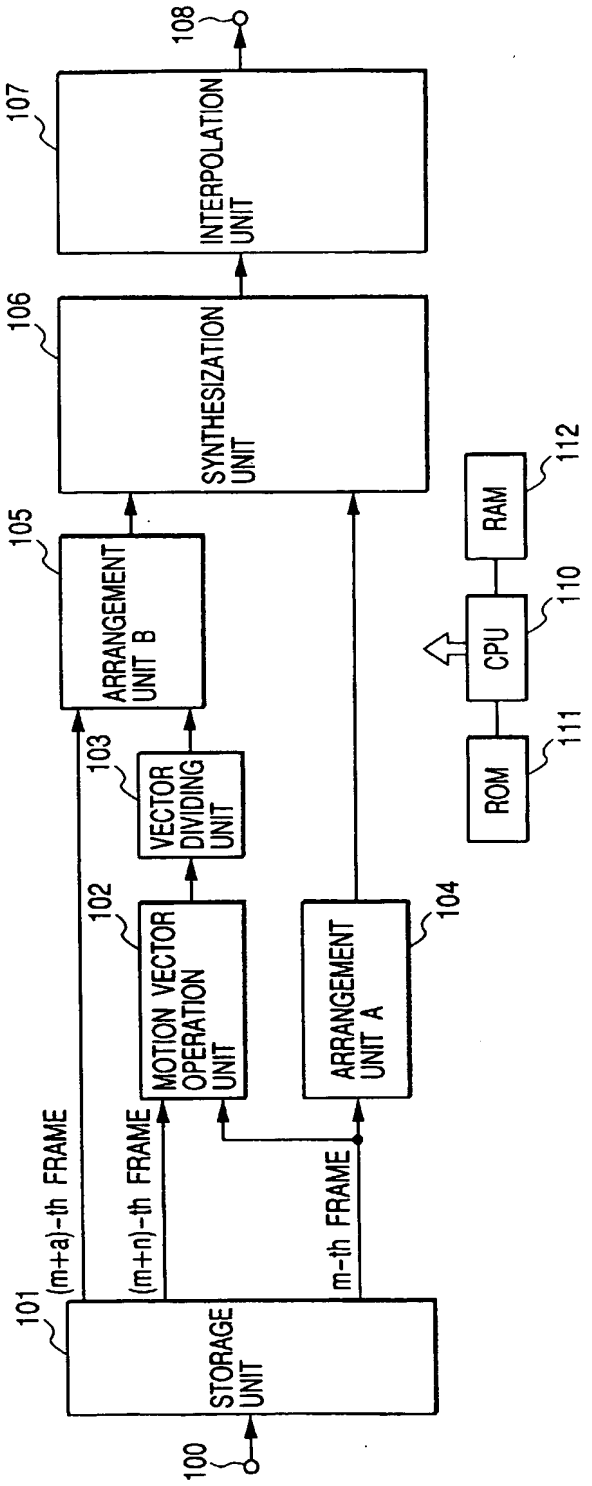
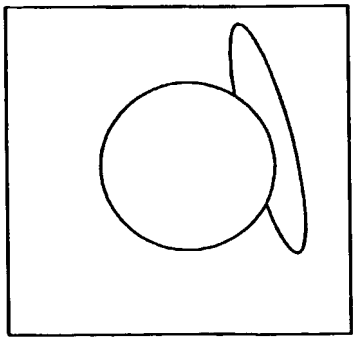
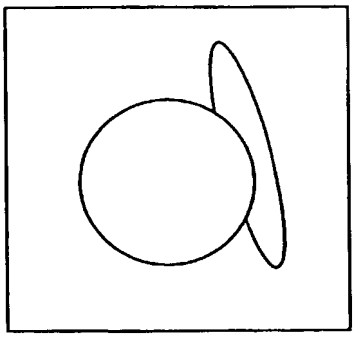

100
101
STORAGE UNIT
(m+a)-th FRAME
(m+n)-th FRAME
m-th FRAME
102
MOTION VECTOR OPERATION UNIT
103
VECTOR DIVIDING UNIT
104
ARRANGEMENT UNIT A
105
ARRANGEMENT UNIT B
106
SYNTHESIZATION UNIT
107
INTERPOLATION UNIT
108
110
CPU
111
ROM
112
RAM

FIG. 6A



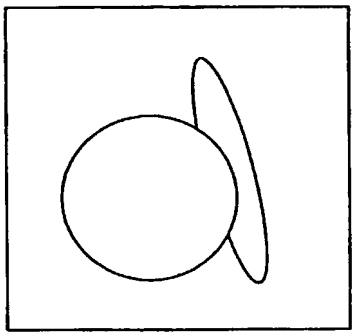
m-th FRAME

FIG. 6B



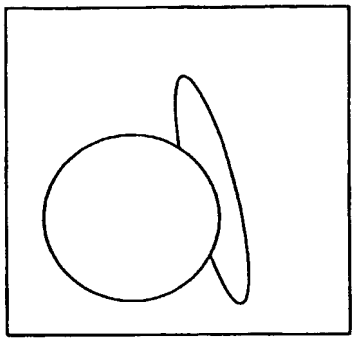
(m+1)-th FRAME

FIG. 6C



(m+2)-th FRAME

FIG. 6D



(m+3)-th FRAME

FIG. 7A

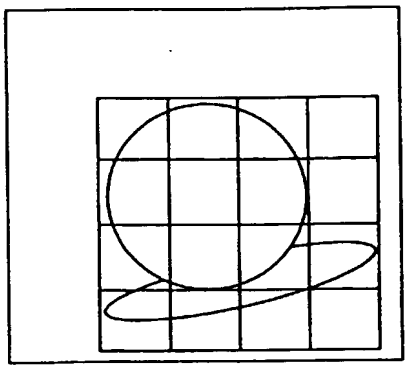


FIG. 7B

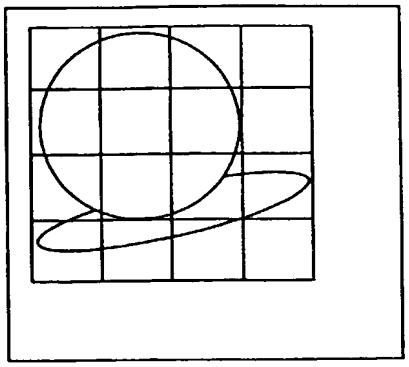


FIG. 7C

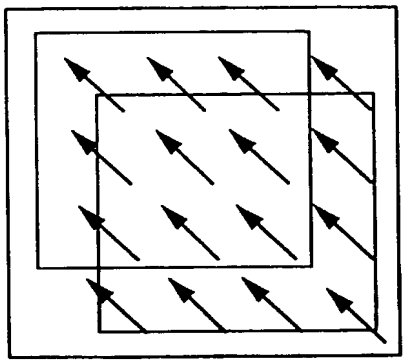


FIG. 8A

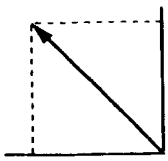


FIG. 8B

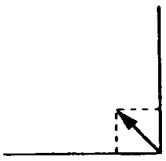


FIG. 8C

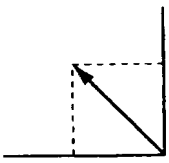


FIG. 9D

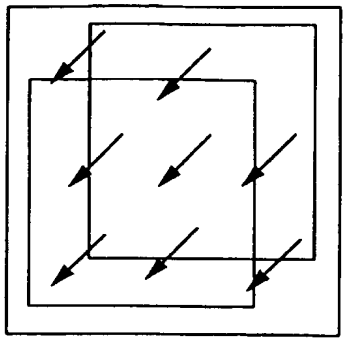


FIG. 9C

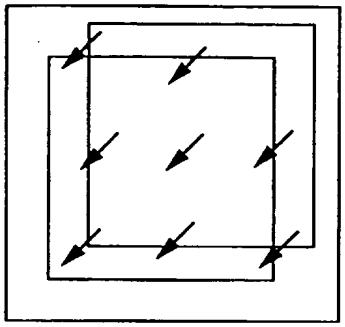


FIG. 9B

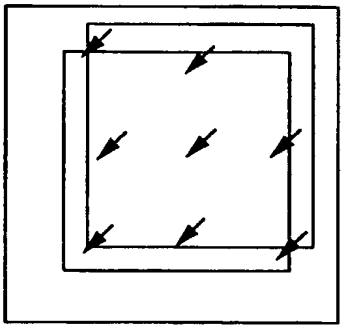


FIG. 9A

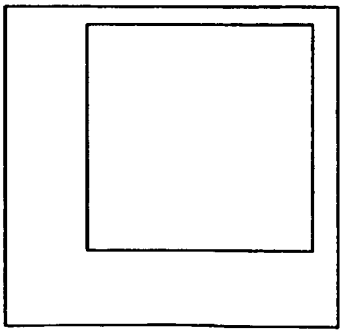


FIG. 10C

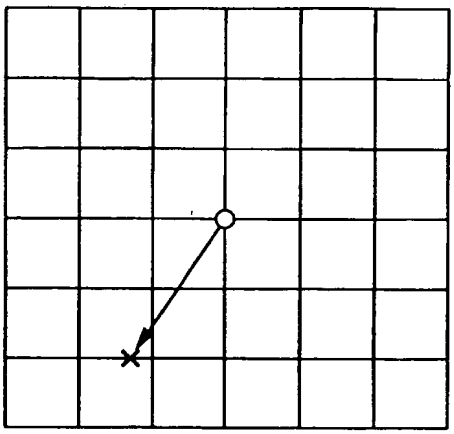


FIG. 10B

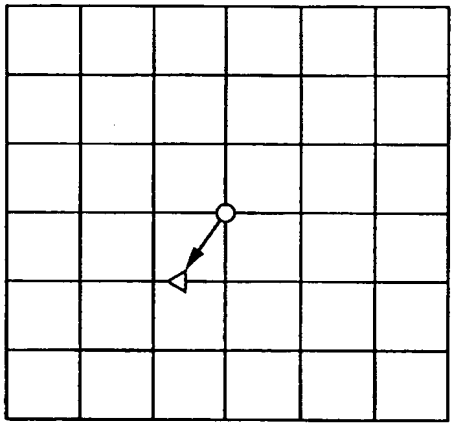


FIG. 10A

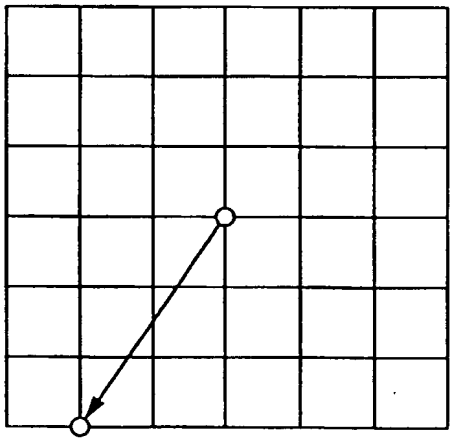
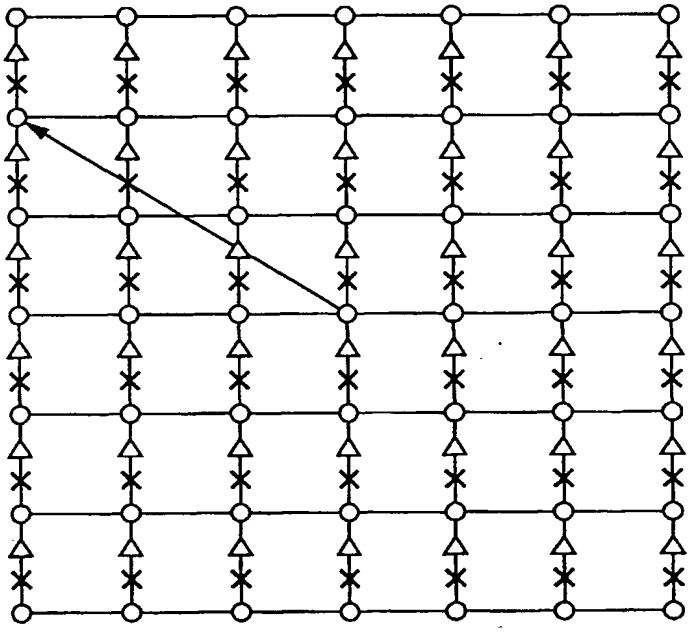


FIG. 11



○: m-th FRAME
△: (m+1)-th FRAME
×: (m+2)-th FRAME

FIG. 12

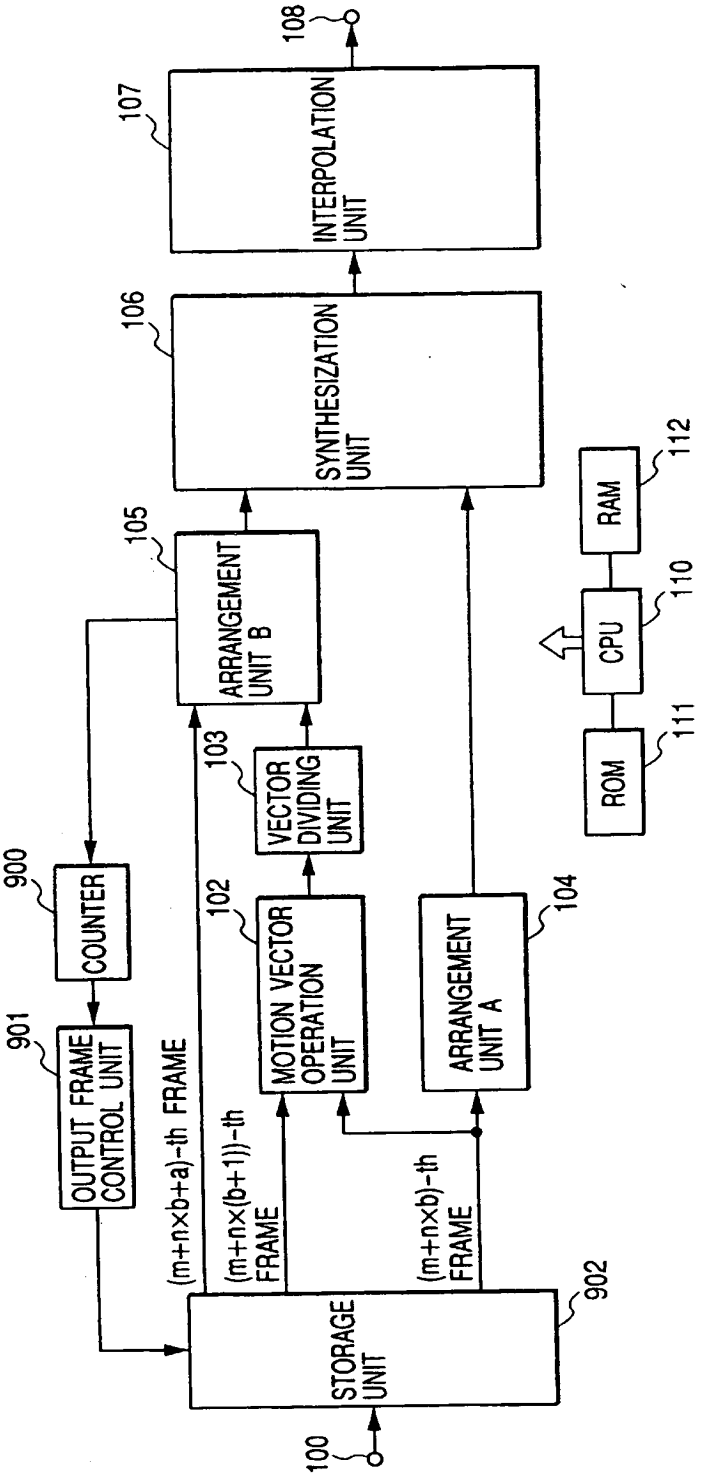

100
STORAGE UNIT
902
(m+n×b)-th FRAME
(m+n×(b+1))-th FRAME
(m+n×b+a)-th FRAME
OUTPUT FRAME CONTROL UNIT
901
COUNTER
900
MOTION VECTOR OPERATION UNIT
102
VECTOR DIVIDING UNIT
103
ARRANGEMENT UNIT B
105
ARRANGEMENT UNIT A
104
SYNTHESIZATION UNIT
106
INTERPOLATION UNIT
107
108
ROM
111
CPU
110
RAM
112

FIG. 13

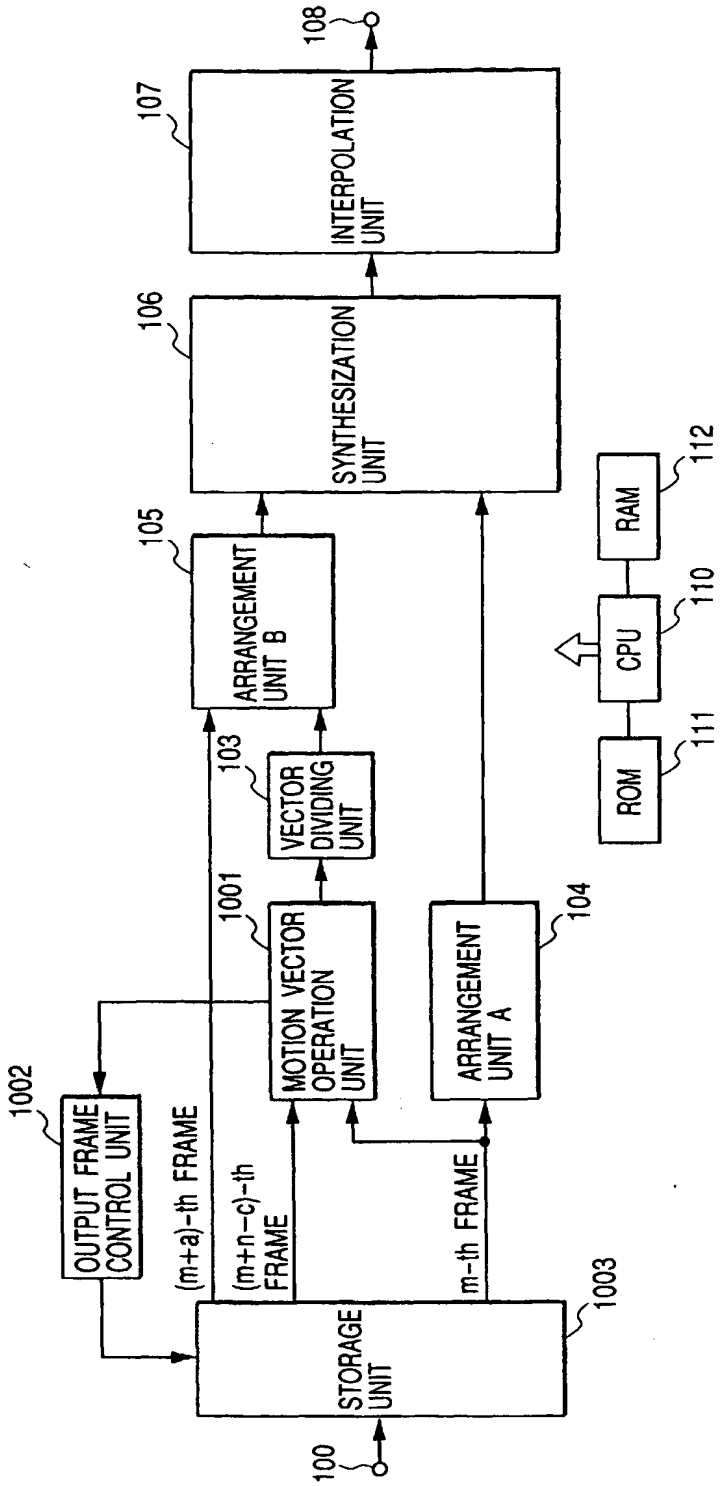

100
STORAGE UNIT
1003
(m+a)-th FRAME
(m+n−c)-th FRAME
m-th FRAME
1002
OUTPUT FRAME CONTROL UNIT
1001
MOTION VECTOR OPERATION UNIT
103
VECTOR DIVIDING UNIT
105
ARRANGEMENT UNIT B
104
ARRANGEMENT UNIT A
106
SYNTHESIZATION UNIT
107
INTERPOLATION UNIT
108
ROM
111
CPU
110
RAM
112

FIG. 14

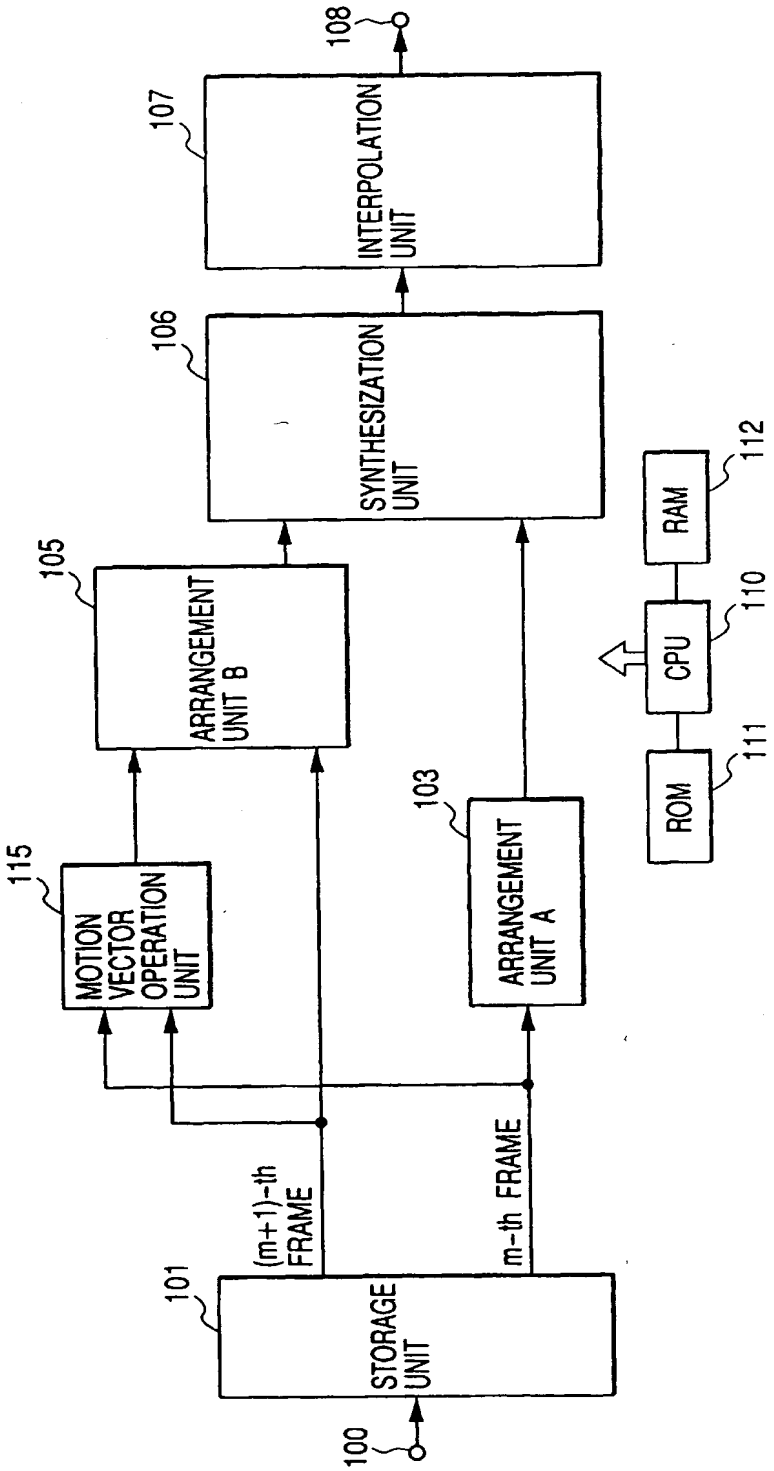

100
101
STORAGE UNIT
(m+1)-th FRAME
m-th FRAME
103
ARRANGEMENT UNIT A
105
ARRANGEMENT UNIT B
106
SYNTHESIZATION UNIT
107
INTERPOLATION UNIT
108
115
MOTION VECTOR OPERATION UNIT
110
CPU
111
ROM
112
RAM

FIG. 15

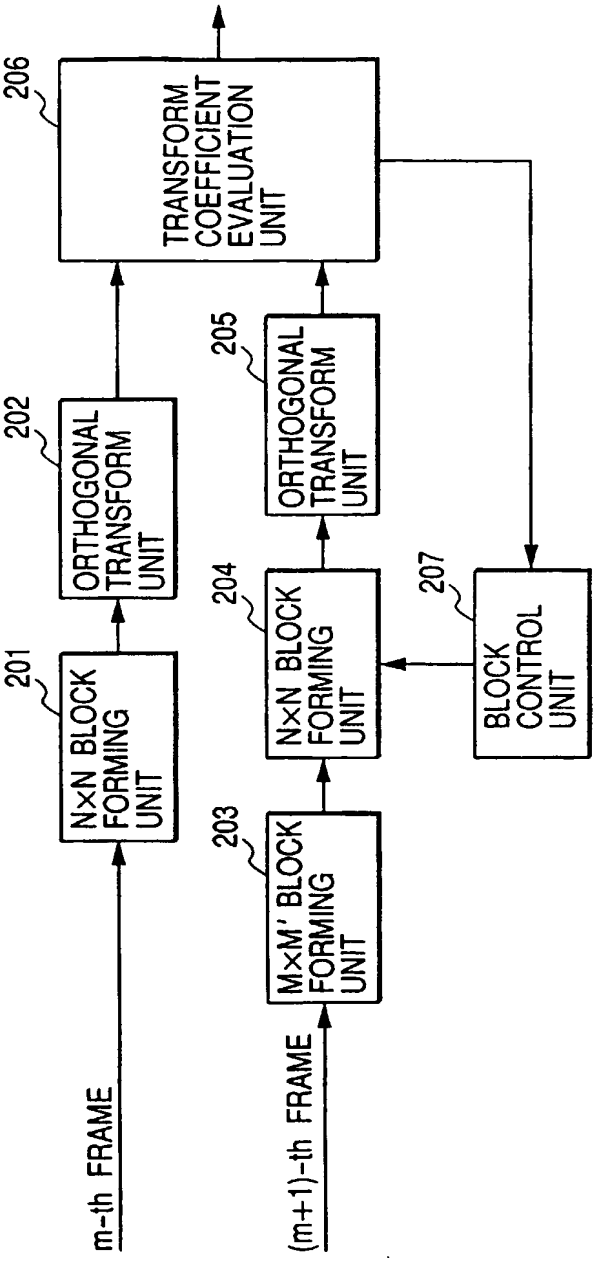

m-th FRAME
(m+1)-th FRAME
N×N BLOCK FORMING UNIT
201
ORTHOGONAL TRANSFORM UNIT
202
M×M' BLOCK FORMING UNIT
203
N×N BLOCK FORMING UNIT
204
ORTHOGONAL TRANSFORM UNIT
205
TRANSFORM COEFFICIENT EVALUATION UNIT
206
BLOCK CONTROL UNIT
207

FIG. 16

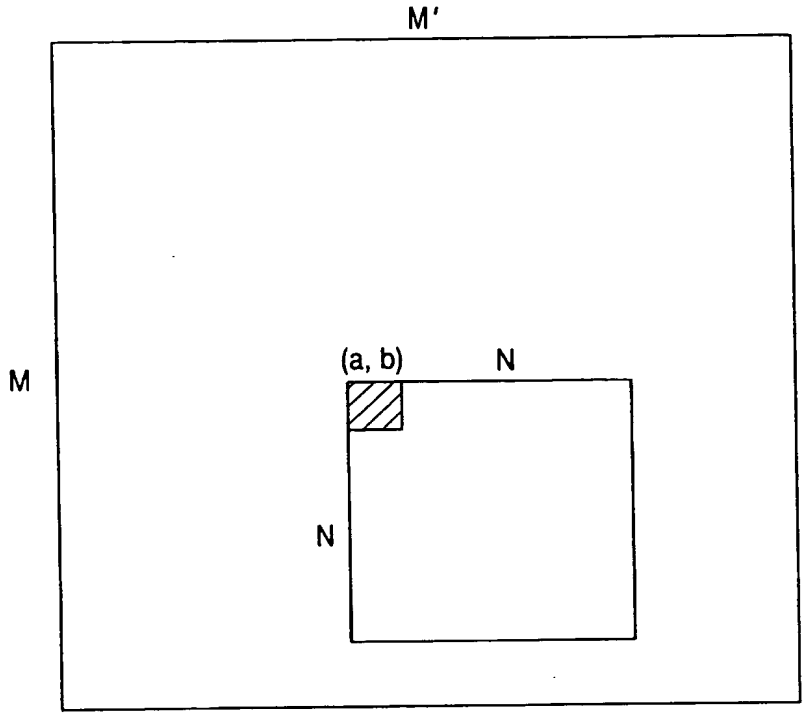


FIG. 18

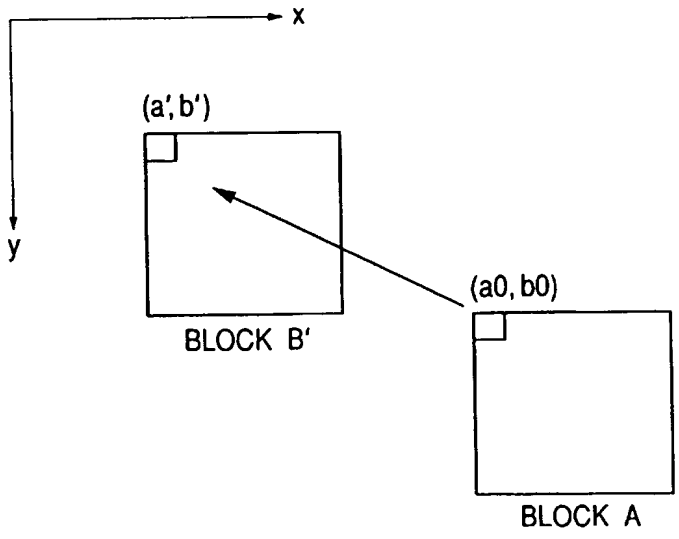


FIG. 17

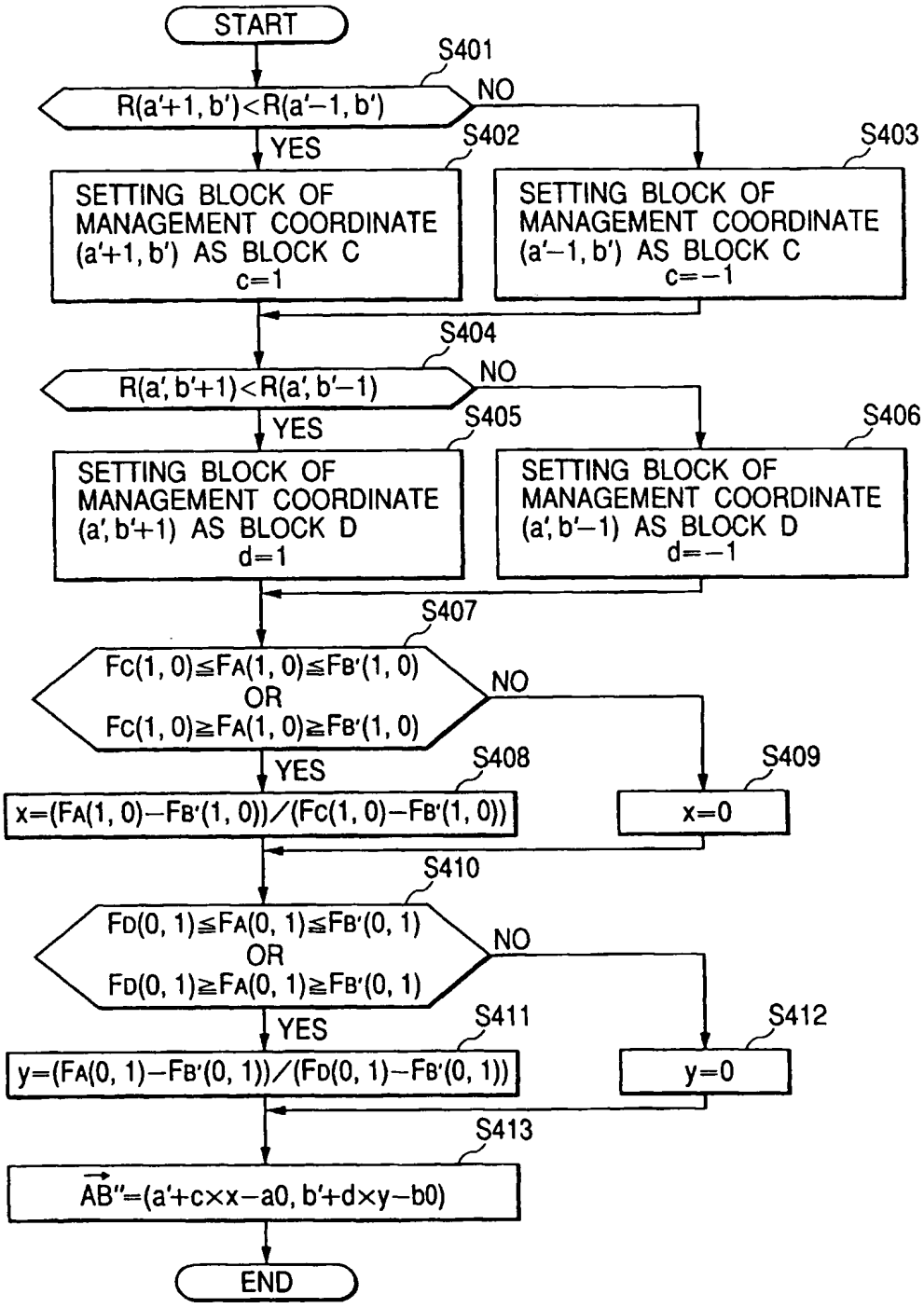

START
S401
R(a'+1, b')<R(a'−1, b')
NO
YES
S402
SETTING BLOCK OF MANAGEMENT COORDINATE (a'+1, b') AS BLOCK C
c=1
S403
SETTING BLOCK OF MANAGEMENT COORDINATE (a'−1, b') AS BLOCK C
c=−1
S404
R(a', b'+1)<R(a', b'−1)
NO
YES
S405
SETTING BLOCK OF MANAGEMENT COORDINATE (a', b'+1) AS BLOCK D
d=1
S406
SETTING BLOCK OF MANAGEMENT COORDINATE (a', b'−1) AS BLOCK D
d=−1
S407
FC(1, 0)≦FA(1, 0)≦FB'(1, 0)
OR
FC(1, 0)≧FA(1, 0)≧FB'(1, 0)
NO
YES
S408
x=(FA(1, 0)−FB'(1, 0))/(FC(1, 0)−FB'(1, 0))
S409
x=0
S410
FD(0, 1)≦FA(0, 1)≦FB'(0, 1)
OR
FD(0, 1)≧FA(0, 1)≧FB'(0, 1)
NO
YES
S411
y=(FA(0, 1)−FB'(0, 1))/(FD(0, 1)−FB'(0, 1))
S412
y=0
S413
$\overrightarrow{AB}''$=(a'+c×x−a0, b'+d×y−b0)
END

FIG. 19B

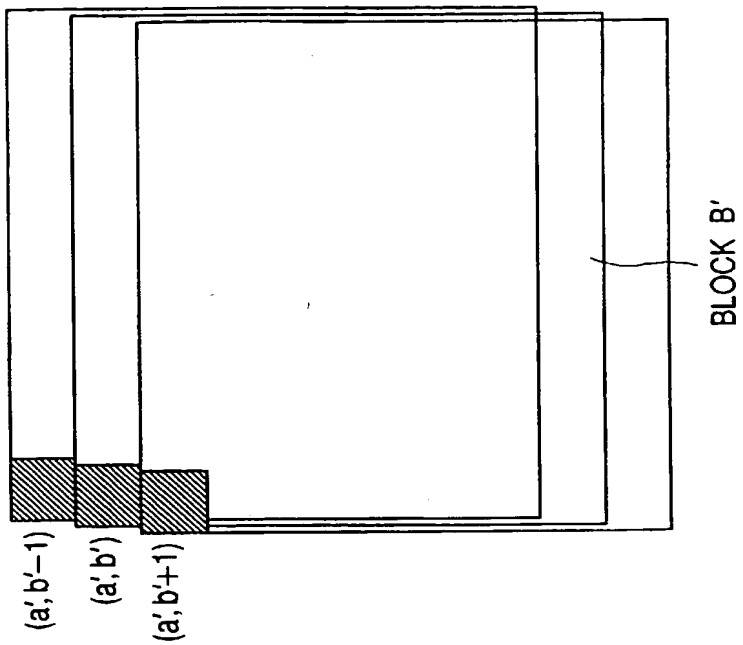


FIG. 19A

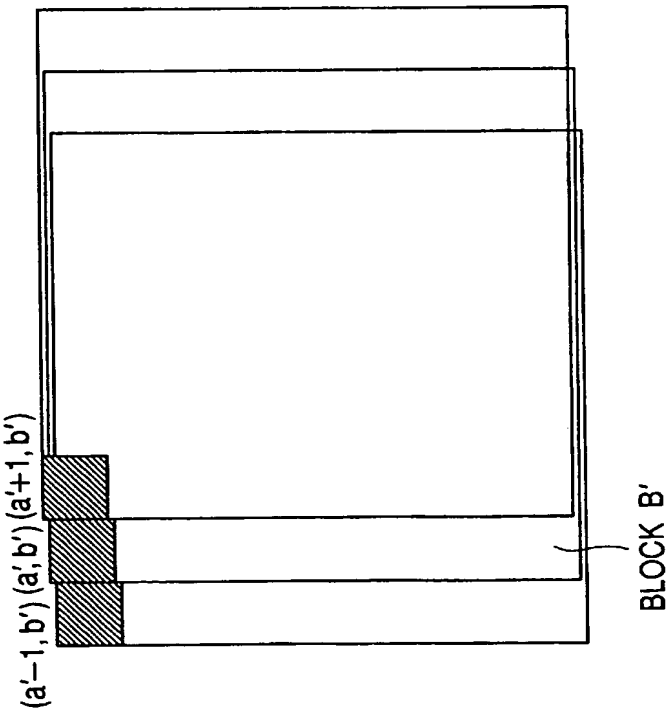


FIG. 20

BLOCK A

IN

63	56	60	54	52	50	46	47
62	73	73	75	83	90	96	99
81	91	99	105	112	117	121	120
102	103	102	103	105	109	110	111
125	121	116	111	112	110	106	103
134	140	140	120	110	106	105	101
137	142	147	137	112	107	105	97
144	145	145	140	114	106	100	88

701

DCT

824.50	36.37	-6.21	-10.28	-9.75	3.45	0.68	-0.24
-157.84	-80.37	7.36	9.76	4.70	-8.01	1.05	2.59
-66.66	32.40	-7.42	-6.94	0.17	6.01	0.76	-1.86
-45.08	35.71	8.77	0.01	-0.79	-1.72	4.12	3.75
-34.75	22.78	2.11	9.37	7.00	2.06	1.83	-0.83
-9.14	8.40	-2.99	-4.30	0.91	3.82	2.45	-0.25
4.34	7.21	-3.24	-0.46	-0.88	0.00	1.42	2.25
7.66	-0.48	-6.23	2.47	2.52	2.11	0.42	0.04

702

FIG. 21

BLOCK B'

IN

65	54	59	56	52	50	46	45
57	73	72	75	82	87	95	99
80	87	98	105	110	115	121	122
102	103	102	103	105	109	110	111
127	124	116	111	112	110	107	103
132	140	142	124	112	106	105	101
136	140	148	140	116	107	105	97
144	145	146	141	114	106	103	86

711

DCT

824.50	35.50	-9.34	-12.17	-8.25	5.78	-1.00	0.11
-162.46	-80.86	9.85	9.29	5.72	-8.08	1.59	1.36
-67.59	32.17	-9.69	-6.17	0.37	8.03	0.26	-1.26
-42.10	37.82	6.31	0.84	0.07	-2.33	3.76	2.95
-32.75	25.75	4.94	13.23	5.00	3.22	1.47	-1.08
-8.12	7.79	-4.68	-2.64	3.71	5.04	4.64	0.45
4.72	6.92	-2.74	-0.36	-0.42	2.69	2.69	1.94
8.08	-0.45	-4.05	3.94	3.89	3.05	1.09	0.48

712

FIG. 22

BLOCK C

IN

54	59	56	52	50	46	45	53
73	72	75	82	87	95	99	99
87	98	105	110	115	121	122	116
103	102	103	105	109	110	111	112
124	116	111	112	110	107	103	103
140	142	124	112	106	105	101	99
140	148	140	116	107	105	97	96
145	146	141	114	106	103	86	88

721

DCT

814.87	41.46	6.37	−1.61	−8.62	−6.73	2.64	−1.23
−134.83	−84.34	−9.12	1.20	8.46	5.17	−4.66	−0.43
−76.47	32.76	2.83	−8.35	−5.58	−5.23	4.65	0.58
−53.76	28.31	12.19	−0.17	4.16	−1.87	−3.50	−1.91
−43.62	15.13	0.25	−0.37	7.37	−1.11	3.55	1.19
−10.64	7.16	−1.27	−7.14	−4.25	−3.27	−1.08	1.03
1.23	8.44	−2.35	−0.80	−2.69	−2.52	−1.58	−0.93
5.79	1.30	−7.72	−2.39	−1.03	0.45	0.45	0.29

722

FIG. 23

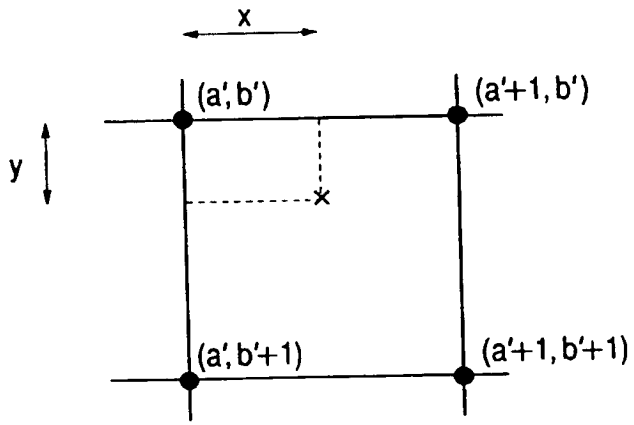


FIG. 24

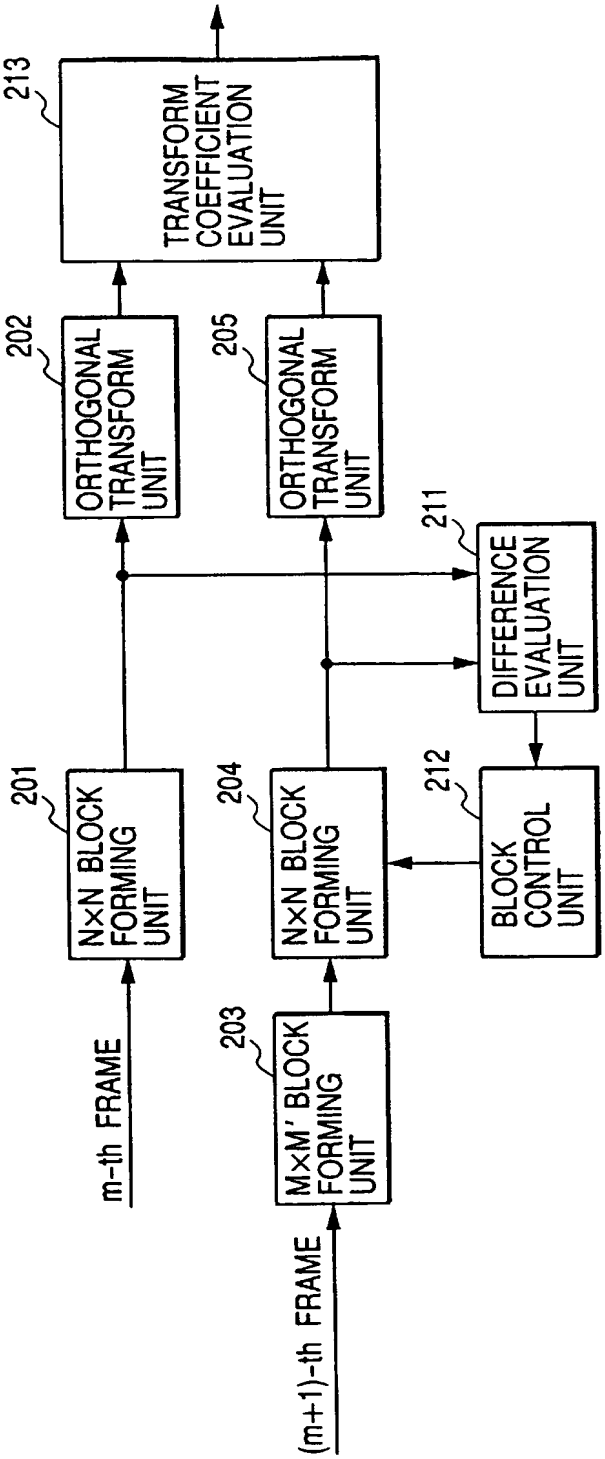

213
TRANSFORM COEFFICIENT EVALUATION UNIT
202
ORTHOGONAL TRANSFORM UNIT
205
ORTHOGONAL TRANSFORM UNIT
211
DIFFERENCE EVALUATION UNIT
201
N×N BLOCK FORMING UNIT
204
N×N BLOCK FORMING UNIT
212
BLOCK CONTROL UNIT
203
M×M' BLOCK FORMING UNIT
m-th FRAME
(m+1)-th FRAME

FIG. 25

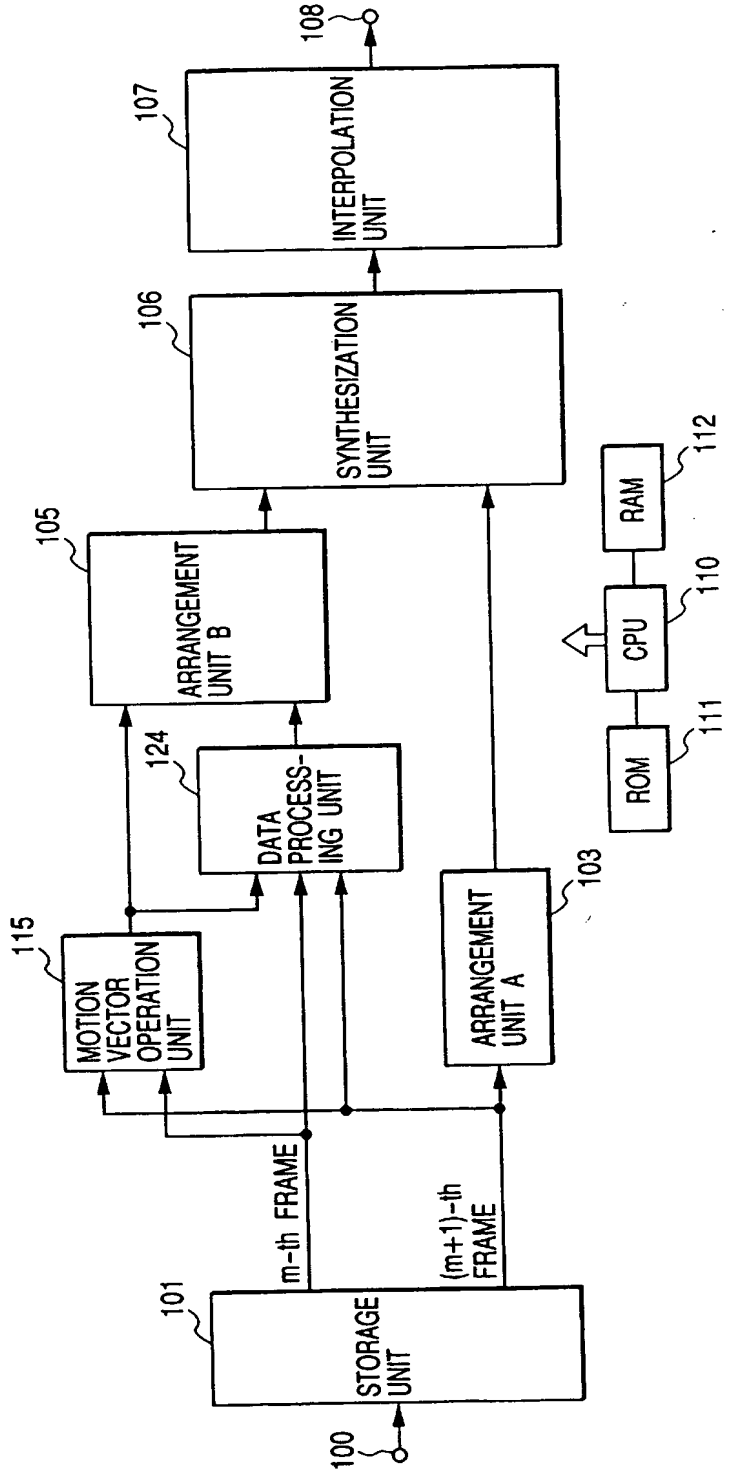

100
101
STORAGE UNIT
m-th FRAME
(m+1)-th FRAME
103
ARRANGEMENT UNIT A
115
MOTION VECTOR OPERATION UNIT
124
DATA PROCESS-ING UNIT
105
ARRANGEMENT UNIT B
106
SYNTHESIZATION UNIT
107
INTERPOLATION UNIT
108
ROM
111
CPU
110
RAM
112

FIG. 26

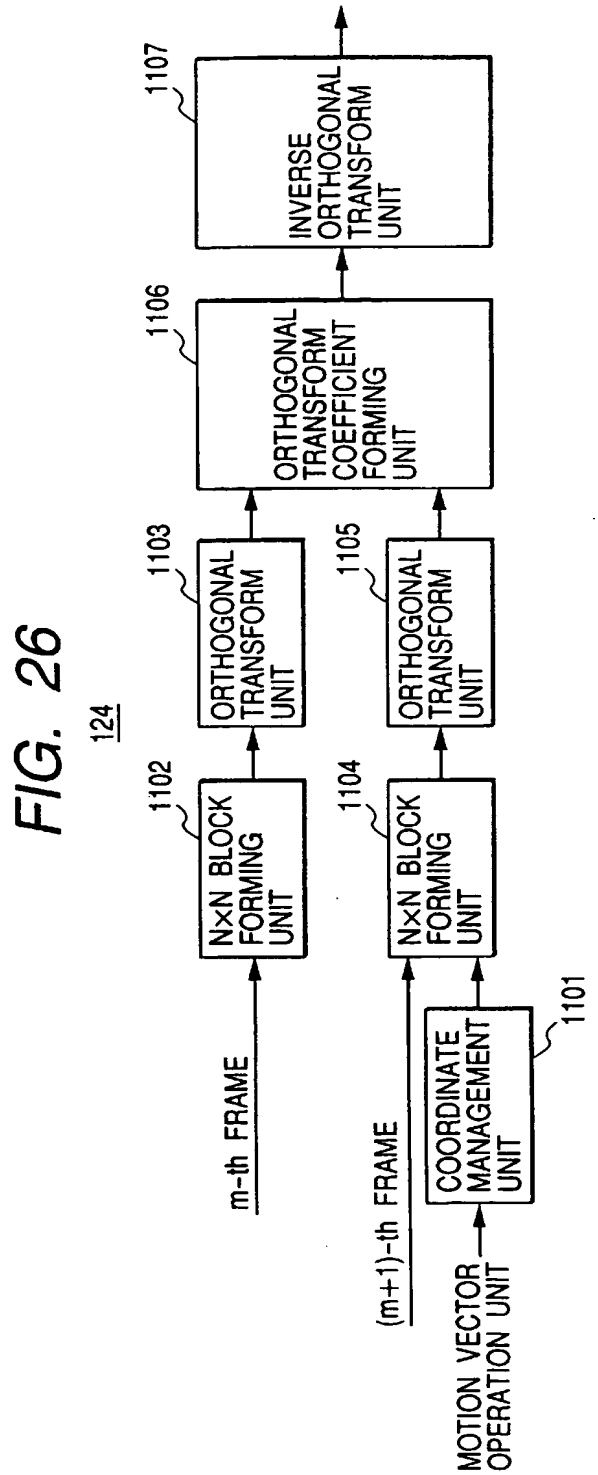

124
1101
COORDINATE MANAGEMENT UNIT
MOTION VECTOR OPERATION UNIT
m-th FRAME
(m+1)-th FRAME
1102
N×N BLOCK FORMING UNIT
1104
N×N BLOCK FORMING UNIT
1103
ORTHOGONAL TRANSFORM UNIT
1105
ORTHOGONAL TRANSFORM UNIT
1106
ORTHOGONAL TRANSFORM COEFFICIENT FORMING UNIT
1107
INVERSE ORTHOGONAL TRANSFORM UNIT

FIG. 27

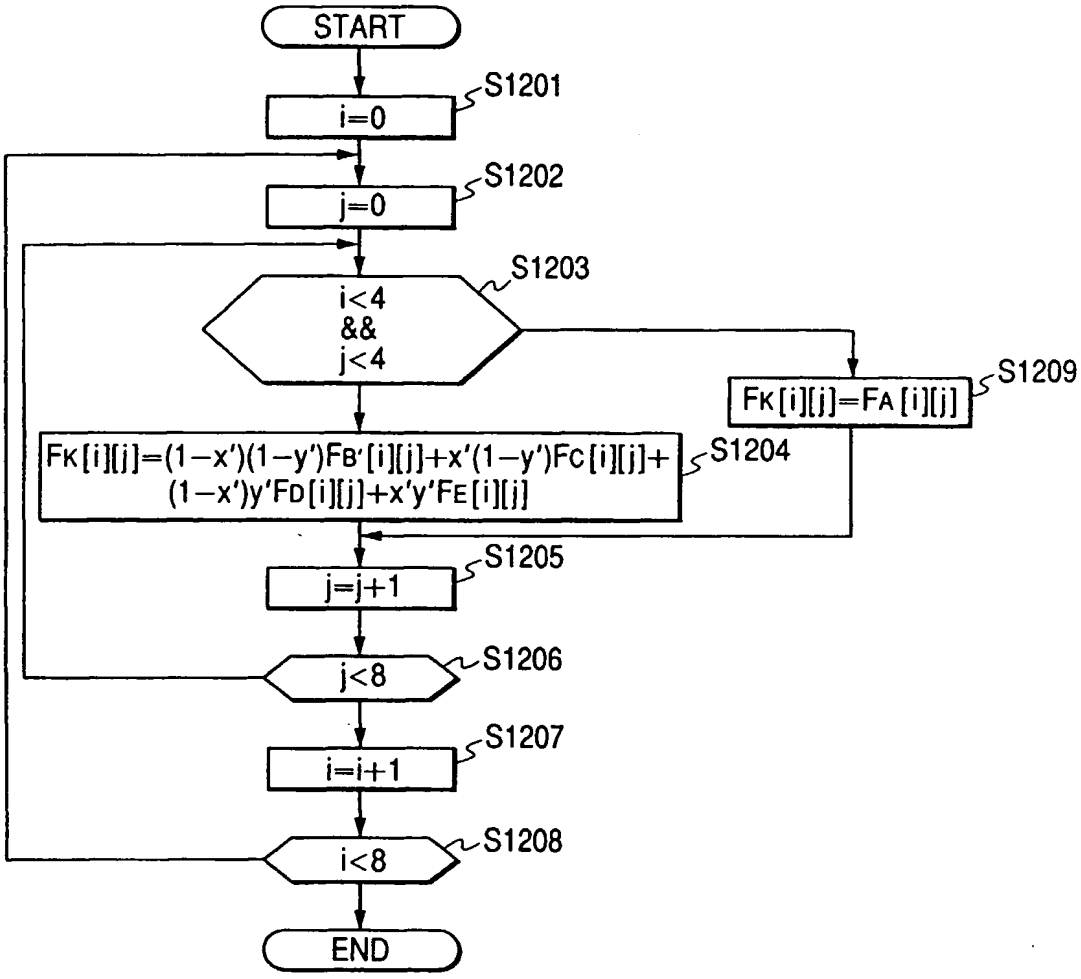

START
S1201
i=0
S1202
j=0
S1203
i<4
&&
j<4
S1209
FK[i][j]=FA[i][j]
S1204
FK[i][j]=(1−x')(1−y')FB'[i][j]+x'(1−y')FC[i][j]+
(1−x')y'FD[i][j]+x'y'FE[i][j]
S1205
j=j+1
S1206
j<8
S1207
i=i+1
S1208
i<8
END

FIG. 28

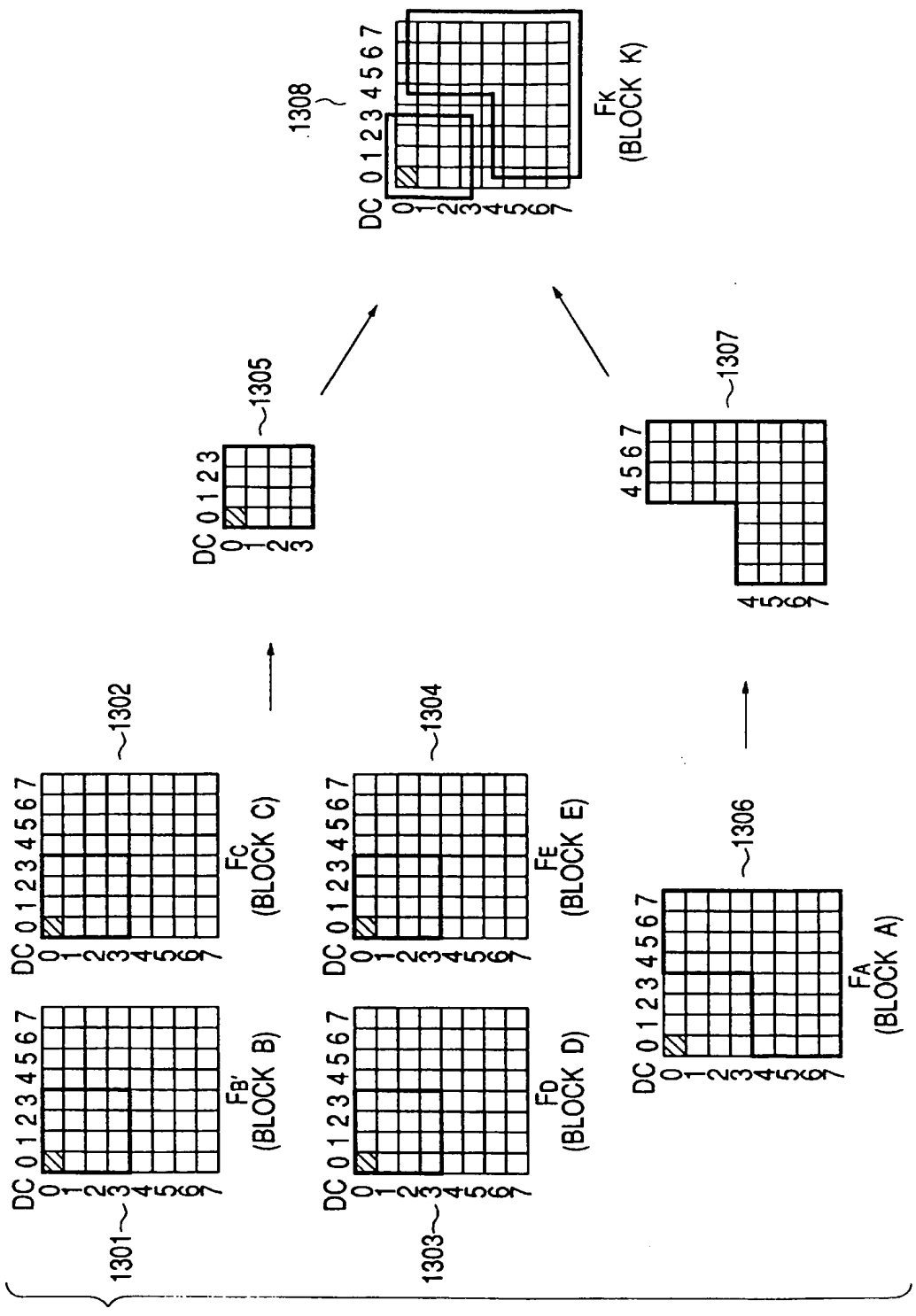

1301
1302
1303
1304
1305
1306
1307
1308
DC 0 1 2 3 4 5 6 7
FB' (BLOCK B)
FC (BLOCK C)
FD (BLOCK D)
FE (BLOCK E)
FA (BLOCK A)
FK (BLOCK K)

FIG. 29

BLOCK A

IN

188	192	191	192	192	198	197	164
191	190	192	197	196	189	114	69
192	197	205	204	188	88	5	40
189	193	197	187	102	0	48	104
190	195	190	101	13	51	117	164
206	203	146	54	45	108	170	202
199	183	118	51	68	145	204	200
198	171	40	0	123	199	196	187

731

DCT

1178.50	174.46	147.27	−12.12	−29.50	−21.41	0.15	2.15
92.83	131.72	−256.40	−41.94	56.76	19.60	5.99	−4.24
112.98	−170.64	−1.32	167.87	−44.20	−24.42	−5.76	−2.32
55.63	−81.43	113.39	−45.84	−60.88	41.36	5.36	−2.86
−11.25	−30.26	40.44	−27.04	9.25	9.59	−15.40	2.65
9.15	10.76	−4.63	−43.49	30.41	10.50	−18.86	10.41
−1.61	5.93	−2.01	14.76	14.79	−31.30	2.57	4.72
−4.93	7.42	−2.74	−9.43	−10.99	1.66	15.49	−3.37

732

FIG. 30

BLOCK B'

IN

188	186	189	192	190	199	206	155
190	187	186	196	205	198	125	62
191	198	201	199	192	80	0	36
191	193	199	188	85	0	26	85
186	200	198	99	0	36	109	161
193	204	151	47	35	106	167	209
203	190	120	37	48	152	206	193
204	176	31	0	103	204	204	188

741

DCT

1159.75	184.32	155.88	−11.60	−47.00	−15.20	2.00	−5.70
95.65	128.49	−276.11	−31.39	68.09	20.30	−0.33	8.22
127.18	−187.82	5.86	185.38	−49.36	13.25	−13.25	−3.28
55.92	−88.27	112.67	−57.29	−66.87	40.80	7.49	3.80
−17.00	−18.24	40.78	−31.54	11.75	19.71	−13.91	−5.83
0.37	22.37	−3.90	−38.99	24.69	11.59	−9.66	6.42
−2.62	−1.38	−1.25	5.44	22.61	35.64	−0.86	7.18
−4.41	10.93	4.07	−13.99	−9.83	0.43	9.39	4.71

742

FIG. 31

BLOCK C

IN

186	189	192	190	199	206	155	125
187	186	196	205	198	125	62	26
198	201	199	192	80	0	36	26
193	199	188	85	0	26	85	139
200	198	99	0	36	109	161	207
204	151	47	35	106	167	209	208
190	120	37	48	152	206	193	189
176	31	0	103	204	204	188	190

751

DCT

1105.25	88.47	157.01	82.13	14.00	−10.74	−4.42	4.15
44.91	277.30	−173.52	−147.21	−37.66	16.85	−0.88	−4.08
117.77	−124.26	−186.44	141.08	69.55	5.52	7.14	1.86
92.27	−122.98	90.11	69.97	−62.01	−44.14	4.46	−3.70
10.50	−64.81	63.27	−21.57	−13.25	−2.99	26.02	−1.41
4.62	11.15	29.11	−36.68	−23.73	10.80	8.41	−7.89
−1.16	−3.39	0.64	−10.89	22.88	28.72	−19.56	−4.13
−5.17	10.38	13.33	2.06	−7.98	−9.66	−9.53	−2.07

752

FIG. 32

BLOCK D

IN

190	187	186	196	205	198	125	62
191	198	201	199	192	80	0	36
191	193	199	188	85	0	26	85
186	200	198	99	0	36	109	161
193	204	151	47	35	106	167	209
203	190	120	37	48	152	206	193
204	176	31	0	103	204	204	188
201	147	6	17	170	203	192	194

761

DCT

1112.87	152.42	204.74	33.09	−35.87	−42.65	−1.87	−4.76
13.94	252.09	−253.98	−143.28	57.57	34.94	17.40	1.36
67.89	−66.93	−139.90	193.03	42.96	−47.76	−16.71	2.11
76.27	−74.98	30.88	55.43	−80.00	11.95	12.74	−4.64
32.13	−63.77	33.48	9.95	−26.62	5.53	6.02	3.31
−0.59	−23.71	34.72	1.93	−34.59	29.50	−1.50	−14.80
10.71	−3.75	−2.21	−17.80	3.45	30.85	−7.85	0.21
3.40	−12.66	2.94	12.87	10.50	−7.93	−9.35	−4.52

762

FIG. 33

BLOCK E

IN

187	186	196	205	198	125	62	26	
198	201	199	192	80	0	36	26	
193	199	188	85	0	26	85	139	
200	198	99	0	36	109	161	207	
204	151	47	35	106	167	209	208	~ 771
190	120	37	48	152	206	193	189	
176	31	0	103	204	204	188	190	
147	6	17	170	203	192	194	190	

DCT

1064.87	21.17	166.91	104.78	56.88	8.46	−8.93	2.86	
−38.30	363.34	−46.29	−191.47	−85.73	−11.08	−7.63	4.04	
25.79	35.66	−258.59	17.45	105.41	54.02	−3.35	−1.00	
64.99	−34.36	−58.78	112.50	−2.63	−35.73	−7.98	7.79	~ 772
45.38	−64.19	−1.94	39.81	−6.12	−13.21	−5.01	−1.45	
10.13	−40.76	21.58	30.50	−10.73	−31.98	23.54	9.04	
14.89	−7.03	5.65	−12.65	−26.75	−8.72	19.84	−3.30	
6.33	−16.23	−5.69	−0.32	12.47	13.50	5.81	2.14	

FIG. 34

BLOCK K

DCT

1134.81	150.17	165.94	21.62	−29.50	−21.41	0.15	2.15	
62.44	194.24	−238.36	−84.09	56.76	19.60	5.99	−4.24	
107.96	−139.26	−74.05	168.01	−44.20	−24.42	−5.76	−2.32	
67.11	−88.91	82.38	−1.68	−60.88	41.36	5.36	−2.86	
−11.25	−30.26	40.44	−27.04	9.25	9.59	−15.40	2.65	~ 781
9.15	10.76	−4.63	−43.49	30.41	10.50	−18.86	10.41	
−1.61	5.93	−2.01	14.76	14.79	−31.30	2.57	4.72	
−4.93	7.42	−2.74	−9.43	−10.99	1.66	15.49	−3.37	

OUT

184	189	192	197	196	190	168	119	
190	191	192	190	179	166	93	52	
195	199	199	182	152	58	0	54	
196	190	179	157	72	0	57	130	~ 782
198	182	159	74	8	65	136	179	
207	184	114	38	61	140	189	201	
190	163	96	46	88	172	215	191	
180	154	29	2	137	214	199	178	

FIG. 35

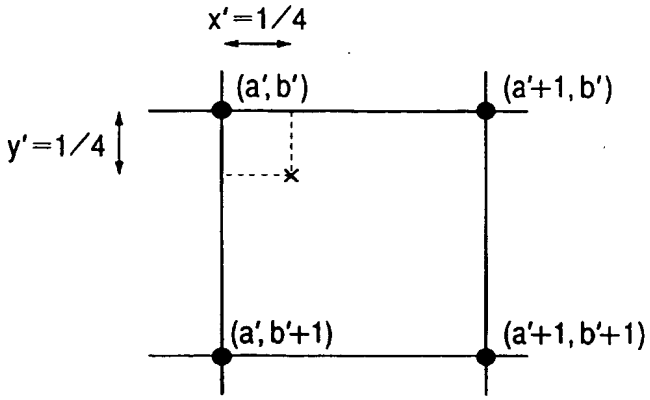

x'=1/4
y'=1/4
(a', b')
(a'+1, b')
(a', b'+1)
(a'+1, b'+1)

FIG. 36

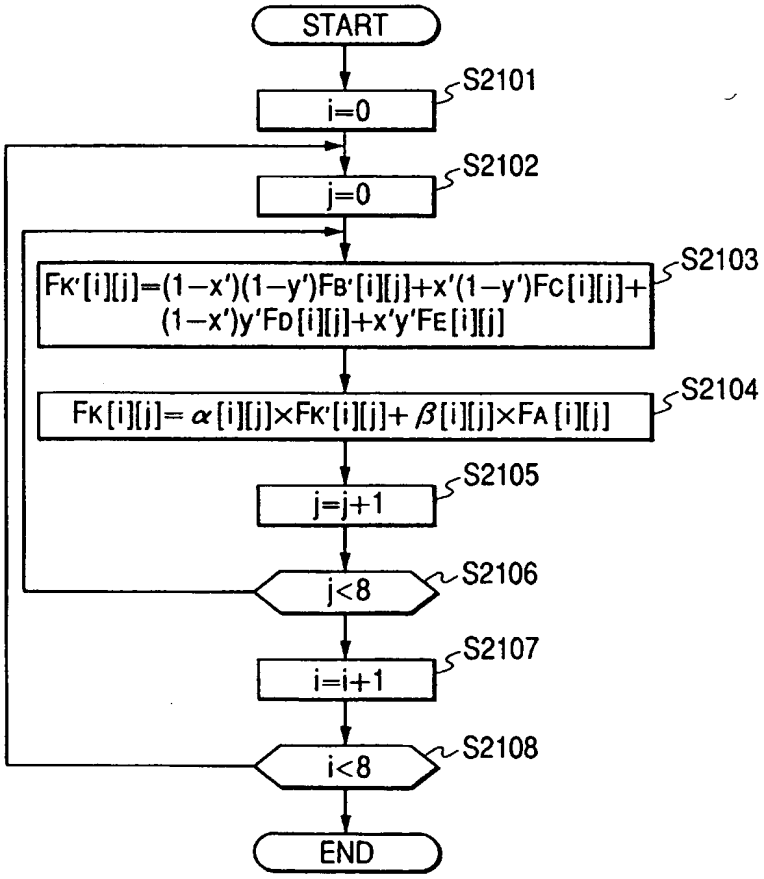

START
i=0
S2101
j=0
S2102
FK'[i][j]=(1−x')(1−y')FB'[i][j]+x'(1−y')FC[i][j]+(1−x')y'FD[i][j]+x'y'FE[i][j]
S2103
FK[i][j]=α[i][j]×FK'[i][j]+β[i][j]×FA[i][j]
S2104
j=j+1
S2105
j<8
S2106
i=i+1
S2107
i<8
S2108
END

FIG. 37

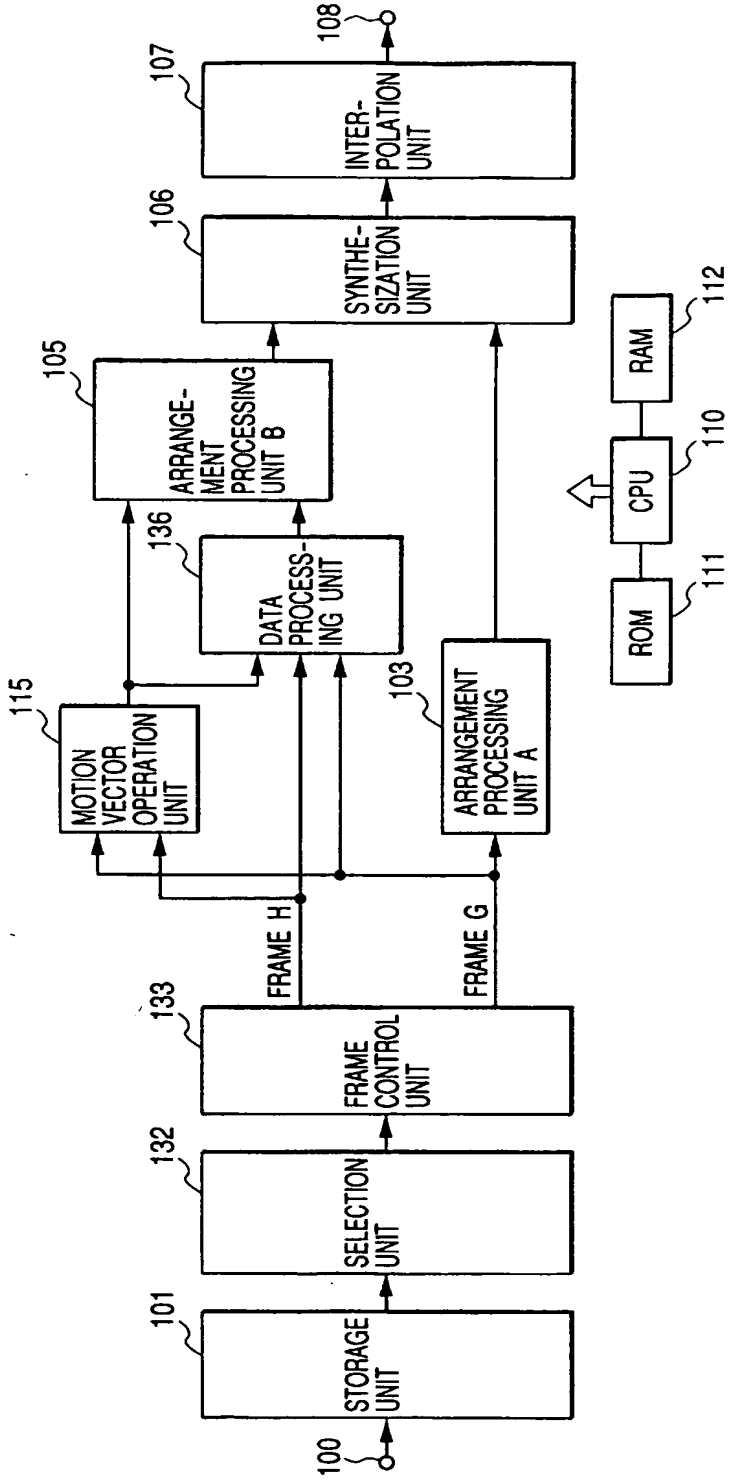

100
101
STORAGE UNIT
132
SELECTION UNIT
133
FRAME CONTROL UNIT
FRAME H
FRAME G
115
MOTION VECTOR OPERATION UNIT
136
DATA PROCESSING UNIT
105
ARRANGEMENT PROCESSING UNIT B
103
ARRANGEMENT PROCESSING UNIT A
106
SYNTHESIZATION UNIT
107
INTERPOLATION UNIT
108
ROM
111
CPU
110
RAM
112

FIG. 38

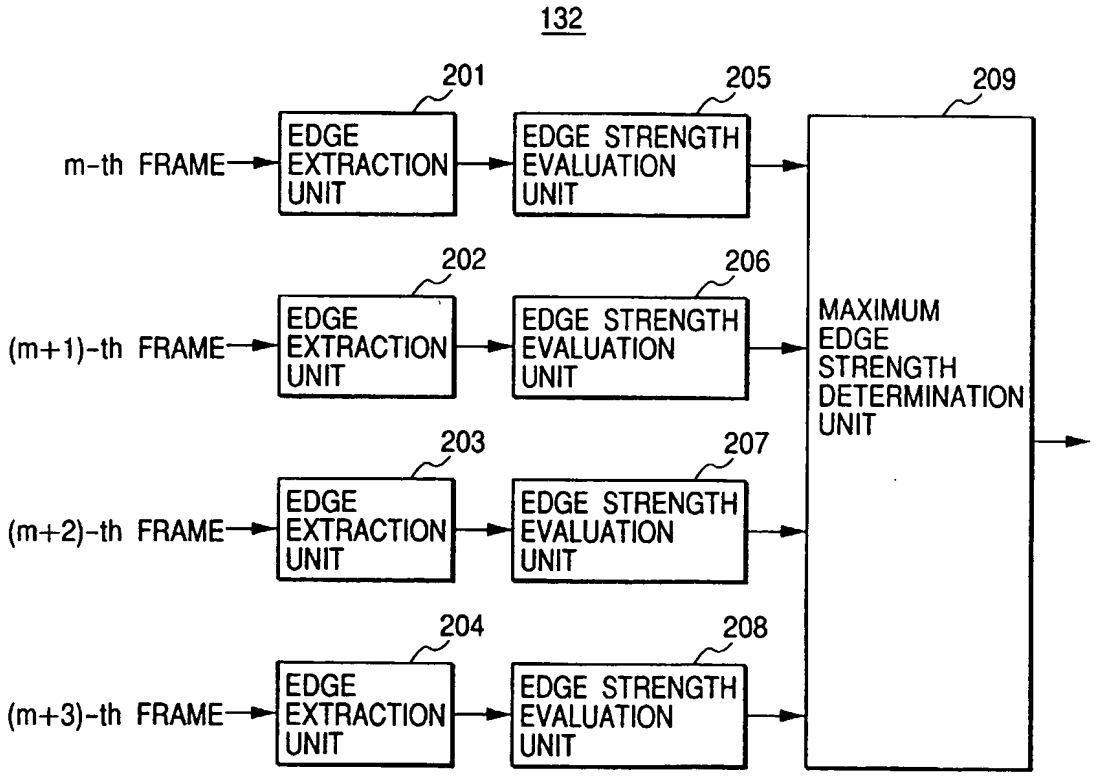

132
201
205
209
m-th FRAME
EDGE EXTRACTION UNIT
EDGE STRENGTH EVALUATION UNIT
202
206
(m+1)-th FRAME
EDGE EXTRACTION UNIT
EDGE STRENGTH EVALUATION UNIT
MAXIMUM EDGE STRENGTH DETERMINATION UNIT
203
207
(m+2)-th FRAME
EDGE EXTRACTION UNIT
EDGE STRENGTH EVALUATION UNIT
204
208
(m+3)-th FRAME
EDGE EXTRACTION UNIT
EDGE STRENGTH EVALUATION UNIT

FIG. 39

1	1	1
1	−8	1
1	1	1

FIG. 41

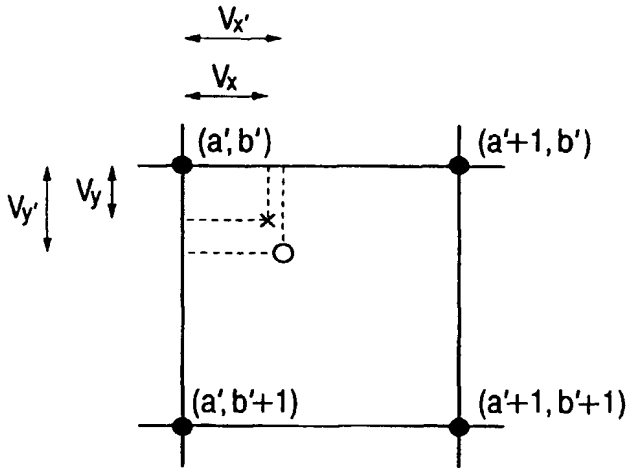


FIG. 40

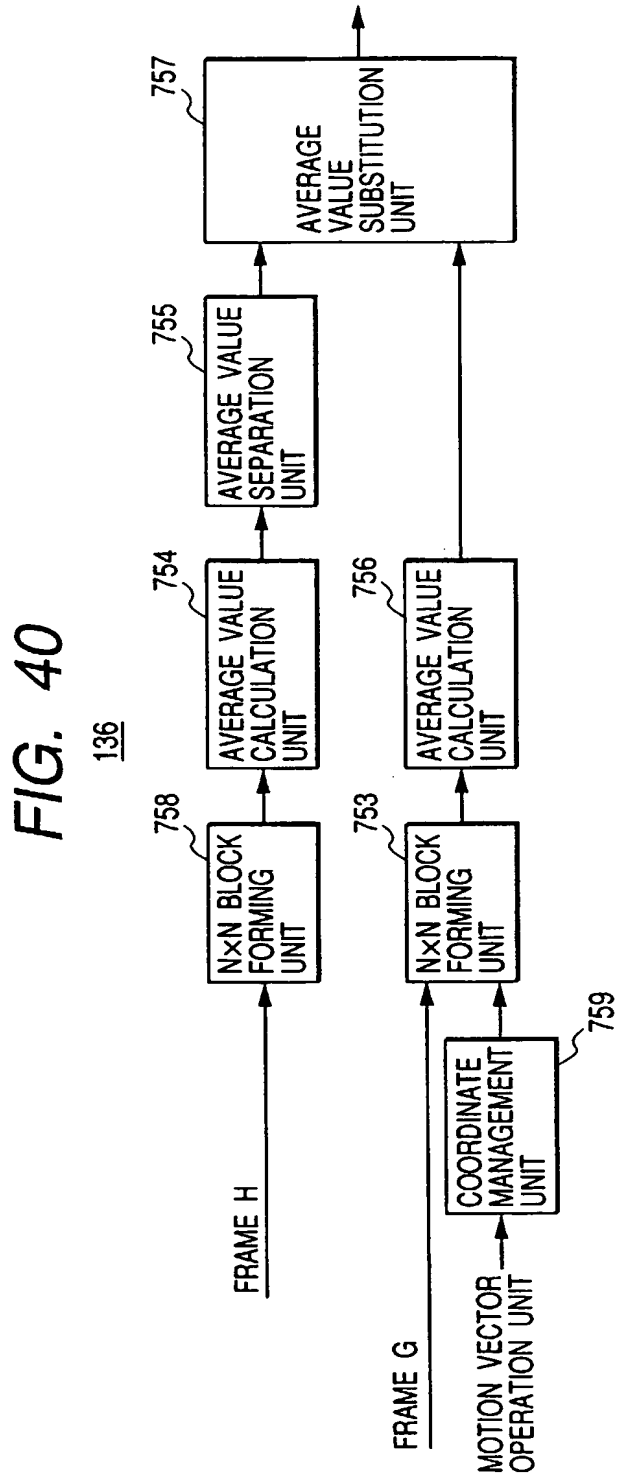

136
FRAME H
FRAME G
MOTION VECTOR OPERATION UNIT
N×N BLOCK FORMING UNIT
758
753
AVERAGE VALUE CALCULATION UNIT
754
756
AVERAGE VALUE SEPARATION UNIT
755
COORDINATE MANAGEMENT UNIT
759
AVERAGE VALUE SUBSTITUTION UNIT
757

FIG. 42

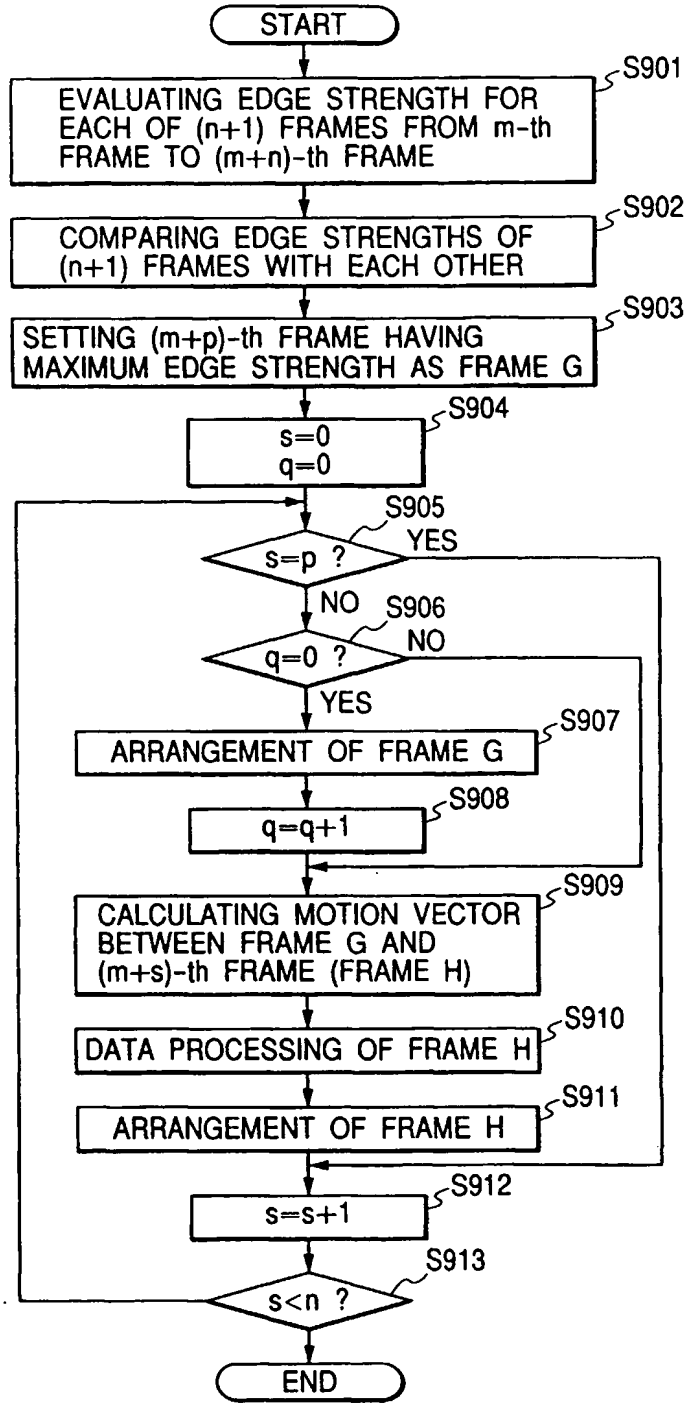
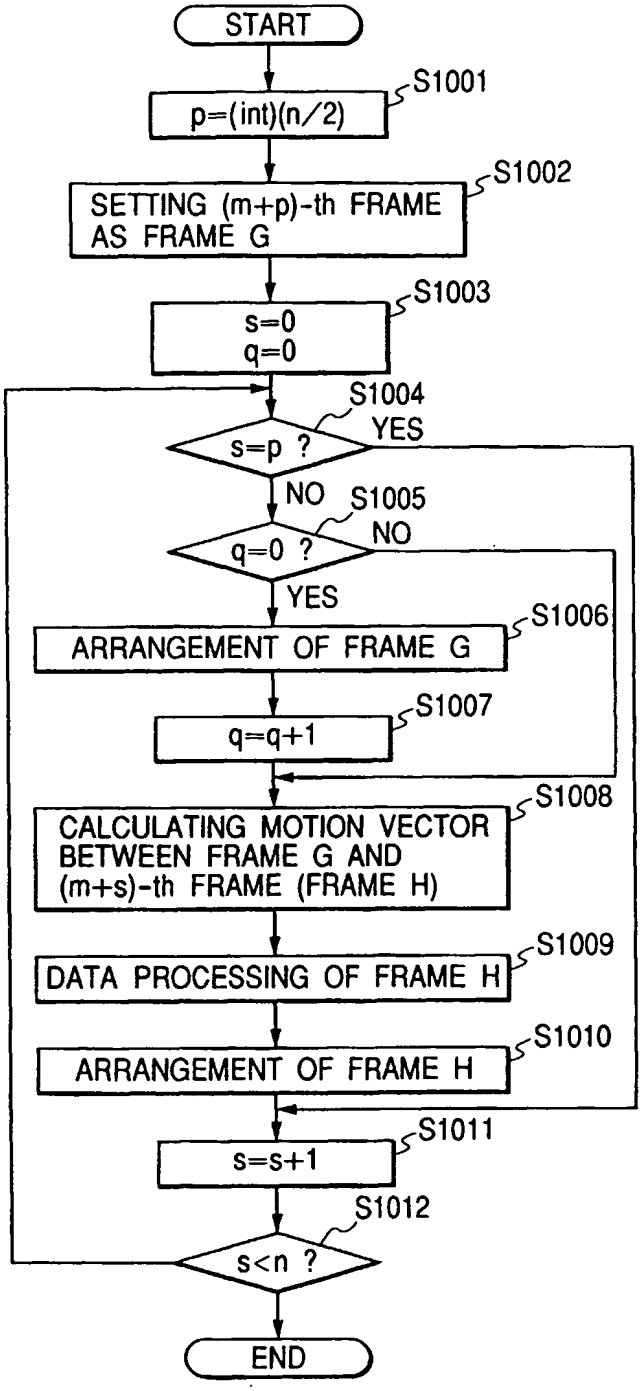

START
EVALUATING EDGE STRENGTH FOR EACH OF (n+1) FRAMES FROM m-th FRAME TO (m+n)-th FRAME
S901
COMPARING EDGE STRENGTHS OF (n+1) FRAMES WITH EACH OTHER
S902
SETTING (m+p)-th FRAME HAVING MAXIMUM EDGE STRENGTH AS FRAME G
S903
s=0
q=0
S904
S905
s=p ?
YES
NO
S906
q=0 ?
NO
YES
ARRANGEMENT OF FRAME G
S907
q=q+1
S908
CALCULATING MOTION VECTOR BETWEEN FRAME G AND (m+s)-th FRAME (FRAME H)
S909
DATA PROCESSING OF FRAME H
S910
ARRANGEMENT OF FRAME H
S911
s=s+1
S912
S913
s<n ?
END

FIG. 43


START
S1001
p=(int)(n/2)
S1002
SETTING (m+p)-th FRAME AS FRAME G
S1003
s=0
q=0
S1004
s=p ?
YES
NO
S1005
q=0 ?
NO
YES
S1006
ARRANGEMENT OF FRAME G
S1007
q=q+1
S1008
CALCULATING MOTION VECTOR BETWEEN FRAME G AND (m+s)-th FRAME (FRAME H)
S1009
DATA PROCESSING OF FRAME H
S1010
ARRANGEMENT OF FRAME H
S1011
s=s+1
S1012
s<n ?
END

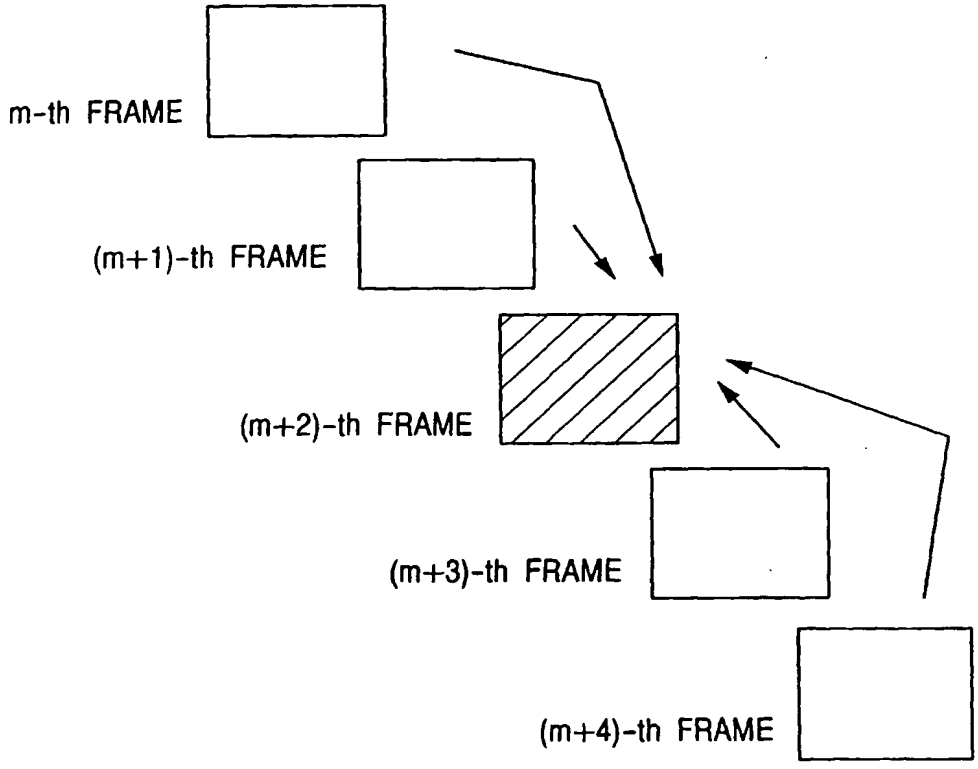



FIG. 44